EVENT STUDY METHODOLOGY FOR THE BORSA ISTANBUL

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ABSTRACT

EVENT STUDY METHODOLOGY FOR THE
BORSA ISTANBUL

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The primary research question of this thesis is to try to determine the appropriate event study methodology for studies carried out on the Borsa Istanbul. In order to find the most appropriate methodology we compare the performance of different models (mean adjusted returns, market adjusted returns, market model) in the Turkish Stock Market with two parametric (portfolio time-series standard deviation test, Patell test) and two non-parametric tests (generalized sign, generalized rank tests) under different return definitions (log versus arithmetic), sample sizes, event windows, and clustering. Also, the sensitivity of results to time period, different databases (Datastream versus Matriks) as well as statistical tools (Excel macros versus Stata) are considered. This thesis basically follows the experimental design of Brown and Warner (1980; 1985) (BW, henceforth) but modifies the test statistics in line with the current developments. According to the results on

Turkish stock market data of 471 securities over 1988-2012, similar to the findings of BW, the mean adjusted returns do not cause a severe specification and power problem under certain circumstances, but in case of clustering, the results suggest not to use the mean adjusted returns. In most of the cases crude adjustment test is well-specified. Besides, samples with larger number of securities and shorter event windows are preferred for the power of tests. Shortening the time period does not affect the results whereas using a different database can cause changes in specification and power.

Keywords: Event study methodology, stock returns, clustering

ÖZ

BORSA İSTANBUL'DA
OLAY ÇALIŞMASI METODOLOJİSİ

Başdaş, Ülkem
Doktora, İşletme Bölümü
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Bu tezin ana amacı Borsa İstanbul verileri kullanılarak yapılacak olay çalışmalarında kullanılması en uygun metodolojileri belirlemeye çalışmaktır. Bu amaçla, Türkiye Pay Piyasası'nda getiri hesaplamada kullanılan farklı modellerin performansları (ortalama ile düzeltilmiş, piyasa getirisi ile düzeltilmiş ve piyasa modeli) iki parametrik (portföy zaman serisi standart sapma testi ve Patell testi) ve iki parametrik olmayan test ile (genelleştirilmiş işaret ve genelleştirilmiş sıralama testi) farklı getiri tanımları (logaritmik ve aritmetik), örneklem büyüklükleri, vaka pencereleri ve kümeleme problemleri altında karşılaştırılmıştır. Ayrıca, test sonuçlarının zaman dilimlerine, farklı veri tabanlarına (Datastream ve Matriks) ve istatistiksel araçlara (Excel ve Stata) hassaslığı da incelenmiştir. Bu çalışmada, Brown and Warner (1980; 1985) (bundan böyle BW) deneysel tasarımı takip edilmek ile birlikte güncel testler de kullanılmıştır. 1988-2012 döneminde Borsa İstanbul'da işlem gören 471 hisse senedi için elde edilen sonuçlara göre, BW tarafından belirtilen sonuçlara benzer şekilde, ortalama ile düzeltilmiş getiriler testlerde anlamlı bir spesifikasyon ve güç problemi yaratmamış, fakat kümeleme problemi olması durumunda ortalama ile düzeltilmiş getirilerin kullanılmaması önerilmiştir. İncelenen senaryoların çoğunda en düşük spesifikasyon hatası portföy zaman serisi standart sapma testi ile elde edilmiştir. Ayrıca, daha fazla sayıda paydan oluşan örneklemler ve daha kısa olay pencereleri ile testlerin gücünün arttığı gözlenmiştir. İncelenen zaman aralığının daraltılmasının sonuçları etkilemediği fakat farklı bir veri tabanı (Matriks ve Datastream) kullanımının spesifikasyon ve güç üzerinde etkili olabileceği bulunmuştur.

Anahtar Kelimeler: Olay çalışması metodolojisi, hisse getirisi, kümeleme

To My Family…

"Hope makes one live"….

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LIST OF ABBREVIATIONS

APT	Arbitrage Pricing Theory
AR	Abnormal Return
BW	Brown and Warner
CAPM	Capital Asset Pricing Model
CAR	Cumulative Abnormal Return
CDA	Crude Dependence Adjustment
ISE	İstanbul Stock Exchange
	(Named as Borsa Istanbul after April 3, 2013)
ETF	Exchange Traded Fund
FFJR	Fama, Fisher, Jensen and Roll (1969)
OLS	Ordinary Least Squares

CHAPTER 1

INTRODUCTION

An event study refers to tests of the impact of an economic or political event on stock prices by adopting different performance measures. Starting from the first event study of Dolley (1933) on stock splits, both the methodology and the application area of event studies are developed. By conducting an event study, Beaver (1968) also investigates the reaction of common stock investors to earnings announcements. Among several studies, early analyses of Ball and Brown (1968), Fama, Fisher, Jensen and Roll (FFJR, henceforth) (1969) and Brown and Warner (1980; 1985) are the major cornerstones. Indeed, the studies of Ball and Brown (1968) and FFJR (1969) introduce event studies whereas Brown and Warner (1980; 1985) describe how to conduct event studies.

According to Binder (1998), FFJR start a "methodological revolution" in finance and Brown and Warner (BW, henceforth) present the basics of the methodology. Binder (1998) underlines two modifications to the methodology after FFJR: use of longer dataset and separation of estimation and event windows. Nevertheless, the main format of event studies has not been changed since FFJR (Kothari and Warner, 2007). Besides, practical importance of assumption violations and adjustments suggested by BW studies provide a benchmark (MacKinlay, 1997). Studies of BW consider monthly and daily stock returns with three basic performance measures (mean adjusted returns, market adjusted returns and market and risk adjusted model). They examine not only models, but also empirical problems such as clustering and cross-correlation.

Despite their importance, the application of BW has remained limited. Same methodology is applied by Kwok and Brooks (1990) on the foreign exchange markets, and Corrado and Truong (2008) and Campbell et al. (2009) consider non-US stock markets. The results on non-US stock markets indicate that there can be differences in results for other markets compared to those of BW; in Campbell et al. (2009) both market adjusted returns and market model perform well for 54 countries, Corrado and Truong (2008) select the market model with equal weighted market index in Asia-Pacific markets and Brown and Warner (1980; 1985) argue to use the market model especially with clustering problem for the US data. Therefore, analysis of other markets, especially developing markets, is an underexplored area.

The primary research question of this thesis is to determine the appropriate event study methodology for studies carried out on the Borsa Istanbul. In order to find the most appropriate methodology we compare the performance of different models (mean adjusted returns, market adjusted returns, and simple market model) in the Turkish stock market with two parametric (portfolio time-series standard deviation test, Patell test) and two non-parametric tests (generalized sign and generalized rank tests) under different return definitions (log versus arithmetic returns), sample sizes, event windows, and clustering. Also, the sensitivity of results to time period, comparisons of different databases (Datastream versus Matriks) as well as different statistical tools (Excel macros versus Stata) are considered. This thesis basically follows the experimental design of BW, but modifies the test statistics in line with the current developments. This thesis contributes to the existing literature by extending the BW methodology in a developing market, actually first time comprehensively for the Turkish stock market. By giving an insight about the underlying model for Turkish stock market this thesis provides a guideline for future studies that would adopt event study methodology in order to investigate the impacts of various political or economic events on stock prices in Turkey.

According to the results on Turkish stock market data of 471 securities over 1988-2012, the percentage of zero returns is around 35 per cent with high non-normality properties supporting the findings on non-normality of returns in Muradoğlu and Ünal (1994) and Campbell et al. (2009). Comparing the results of arithmetic and logarithmic returns, there are some changes in both directions in specification error and power for tests implying that none of them dominates the other one. Focusing the results of BW (arithmetic returns for crude dependence test), with Turkish data the specification error is a little bit larger and the power of tests is lower. After adding 2 per cent abnormal artificial return at time zero, the power of tests is still around 85 per cent whereas BW indicate nearly 100 per cent. One possible explanation for this finding can be the difference between the US and Turkish markets, which necessitate applying further methods for Turkey that would result in lower specification error and higher power even though there is not a big gap between the results.

Whenever the sample size decreases from 50 securities to 20 securities, there is a slight decrease in the specification error, (like BW and as expected[1]). Even though there is no significant gain in the specification error, the power of tests dramatically changes. Therefore, a researcher should prefer the samples of 50 securities over samples of 20 securities as conducting an event study for Turkish stock markets. Comparing different event windows ((-5,+5), (-1,+1) and one-day event window), there is not a big change in specification error, but power of tests increase significantly in all cases whenever the event window shortens, as found in BW.

Whenever the clustering problem is introduced by restricting the same event date for all securities in a given sample, both the specification error dramatically rises and the power of tests significantly decreases. Therefore, clustering significantly alters the results, and hence clustering is a severe problem that should be avoided in the Turkish stock market. Mean adjusted returns cannot perform well under clustering problem; so that this performance model should not be preferred for the Turkish stock market data. To illustrate; a researcher willing to investigate the impact of the inflation announcements on stock returns should use the market model or at least market adjusted returns to test the significance of abnormal returns.

As shortening the time period from 1988-2012 to 1999-2012, there is not a significant improvement in the specification error. With the replication of all tests with the Matriks Database, there is no benefit of using the Matriks database from the point of specification error. However, with the Matriks data the power of tests slightly increases in most of the cases. With Matriks

[1] Kothari and Warner (2006) indicate that as the sample size gets larger, so the power of tests.

database the differences between the three methods in the specification error lowers compared to those with Datastream. In fact, this finding strengthens the results of BW; under certain circumstances the mean adjusted returns do not cause a significant specification and power problem. Lastly, the results with the Stata codes support the finding that the mean adjusted returns do not cause a significant and power problem.

In general, the crude dependence adjustment test is preferred in most of the cases supporting the view that there can be return variance increases so that a parametric test performs better than parametric ones. However, the findings for Borsa Istanbul do not support the finding of Corrado and Truong (2008), which claim that non-parametric tests, especially the generalized rank test, outperform the others. Also, like BW, the results indicate that the mean adjusted returns do not cause a severe specification and power problem under certain circumstances, but in general market model [2] or market adjusted returns should be used (especially under clustering) not to have misleading test results. By using the CDA (crude dependence adjustment) test and arithmetic mean adjusted returns, a researcher can detect an abnormal return of 1 per cent (when actually there is abnormal return) with 33 per cent probability in Turkish stock market. This probability goes up to 81 per cent in case of 2 per cent abnormal returns. Therefore, a researcher should know the nature of the event and possible impact on returns in advance of an event study for Turkey. It should be noticed that in case of events that can affect the returns with a slight change

[2] It is important to note that market model also seems to fit the Turkish stock market data even though the returns demonstrate highly non-normal properties and the underlying assumptions of market model should be accepted in advance.

such as 0.5 per cent, the power of tests would be very low (around 15 per cent).

Another practical finding of this thesis is the comparison of databases. Especially for the practitioners using various databases should be cautious on the content. The results based on two different databases (Datastream and Matriks) show that the adjustments on prices by different databases could also affect the return calculation method used for best fitting model.

This thesis is organized as follows: Part 2 reviews the literature; Part 3 explains the data and briefly introduces the Borsa Istanbul of Turkey. Then, Part 4 provides information on experimental design. Part 5 discusses the results, and the sensitivity of results is analyzed in Part 6. Lastly, Part 7 concludes.

CHAPTER 2

LITERATURE SURVEY

The main aim of an event study is to quantify the abnormal or unexpected impact of an economic/political event on security prices. Considering the wide coverage of the event studies, as indicated in Corrado (2011), no one really knows the number of published event studies. Only over 1974-2000 five major finance journals published 565 articles with event study results (Kothari and Warner, 2007). Even though event study test are not direct tests of efficiency, the timing and persistence of events' impact may give information about the structure of the market. In other words, initial test itself is not a test of efficiency, but persistence is. Fama (1970) states that semi-strong form tests of efficiency concern "the speed of price adjustment to other obviously publicly available information" (such as announcements of stock splits), not the magnitude of price changes.

Fama (1970) describes an informationally efficient market as "a market in which prices always fully reflect available information". In the same study, Fama classifies the whole information set into three sub-sets: weak, semi-strong and strong form efficiencies[3]. According to the semi-strong form

[3] An efficient market is described as "a market in which prices always fully reflect available information" (Fama, 1970). Malkiel (1992) re-states the view of Fama as follows: "market is said to be efficient if it fully and correctly reflects all relevant information in determining security prices. The market is said to be efficient with respect to some information set". As in the first well-categorized study of Fama (1970), three subsets of information are defined as

efficiency, all publicly available information should already be reflected in prices. Therefore, in an inefficient market either information to the market affects prices even though it is already available to market (i.e., information is known publicly)[4], or the impact of new information does not fade away. Correspondingly, the duration of the adjustment, not the abnormal returns, would be direct tests of efficiency.

2.1 Event Study and Performance Measures

Because an event study tests the abnormal performance, first priority becomes modeling the expected returns. As Kothari and Warner (2007) indicate, you cannot measure the abnormal/unexpected returns without modeling the normal/expected returns. In general, each study focuses on one normal return generating model. Nevertheless, as in Brown and Warner (1980; 1985), it is common to employ various models to compare the results.

Considering different performance measures used by previous studies (Table 1), there is not a comprehensive single model. Each model has some drawbacks to handle some common features of return data (non-normality, heteroscedasticity, cross correlation, etc.), but apart from these model-specific

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follows: (a) Weak-form efficiency: According to the weak form efficiency, current prices reflect past prices and returns, so an investor can predict the prices by using this set of information, and an investor cannot earn excess returns In other words, this information set contains only the history of prices and returns. (b) Semi-strong form of efficiency: This information set includes all information known by all market participants. This means that current prices reflect all publicly available information. (c) Strong-form efficiency: This information set contains private information (i.e., "the monopolistic access to any information relevant for price formation"). Comparing the performance of insiders with the market, if the insiders can beat the market, then the market is concluded to be inefficient.

[4] In an efficient market, any predictable future prospects of a company have already been priced into the current value of the stock. If a recovery, for example, is already anticipated, the actual recovery is not news. The stock price should already reflect the coming recovery.

problems, as Fama (1991) indicates, all tests suffer from the "joint-hypothesis problem". Joint hypothesis problem means that all tests would be a test of both the selected model and efficiency, so you cannot separate one from the other. In other words, as long as the correct model is not chosen to model the expected returns, any test of abnormal returns could be misleading. Selection of the correct model helps to reduce the noise term and increase the power of tests. In case of selecting a wrong model, Binder (1998) underlines several model misspecification errors, such as omitted variable problem, or inclusion of irrelevant factors. This means that all tests and inferences based on these statistics would be misleading. Therefore, the choice of the model(s) is one of the most crucial steps of an event study.

Comparing previous studies, Brown and Warner (1980) find that market adjusted model, mean adjusted returns and market and risk adjusted simple market model perform similarly, but whenever there is clustering problem, mean adjusted returns performs badly. Other papers (Armitage, 1995; MacKinlay, 1997) also indicate the poor performance of mean adjusted model. This implies that mean adjusted method is not able to handle problems of heteroscedasticity and autocorrelation as the market model deals with. On the other hand, there are still differences in test results when both CAPM and market model are applied to same dataset (Brenner, 1979; Brick et al., 1989). As a rule of thumb, market and risk adjusted models (market model, CAPM, APT, etc.) perform better than the ones without any market or risk adjustment, and the market model is the most common one (Armitage, 1995). MacKinlay (1997) argues that due to the questionable validity of restrictions imposed by the CAPM, the market model is more common than the CAPM. In a recent study by Campbell et al. (2009) the classification of event study articles on multi-country samples indicates that the benchmark models are generally the market adjusted returns and simple market model.

In line with Brown and Warner (1980; 1985) this thesis uses three models (mean adjusted, market adjusted and simple market model) to examine the security performance. As Armitage (1995) argues, beyond the market model complex methods and further adjustments add little benefit[5] to the performance. Therefore, the most popular benchmark models are employed for this first analysis on the Borsa Istanbul. After this first attempt, an extension of this study by incorporating other measures may be conducted.

[5] This means that with the complex models, decrease in specification errors and increase in power of tests are negligible.

Table 1. Summary of Abnormal Return Generating Performance Models

MODEL	ABNORMAL RETURN DEFINITION
Zero adjustment to returns	Actual return on a share is regarded as the abnormal return.
Mean adjusted returns	This model assumes that a share would earn the average return, which is calculated over an estimation period, before or around the event date. Any deviation from the mean would be the abnormal returns.
Market adjusted returns (Index Model)	Market adjusted returns are the returns of a share over the market returns. Therefore, this approach assumes that on average a share should earn same as the market. Unless beta of sample is equal to 1, the index model can lead potential bias by increasing variance and lowering the power.
Market and Risk adjusted models	This approach assumes that as eliminating the market's impact on actual returns of a share, the risk factor of the firm should also be incorporated.

Table 1 (cont'd)

a. Simple Market Model $R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$	Different than the index model, now returns are adjusted for the risk factor of that share as finding the expected returns. After finding R from the estimation period, the abnormal returns over the event window are: $AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt})$
b. Capital Asset Pricing Model (Sharpe-Lintner) $R_{it} = R_{ft} + \beta_i (R_{mt} - R_{ft}) + \varepsilon_{it}$ or in another way $R_{it} = (1 - \beta_i) R_{ft} + \beta_i R_{mt} + \varepsilon_{it}$	Compared with the simple market model, now the excess returns over risk free rate are used. $AR_{it} = R_{it} - (R_{ft} + \beta_i (R_{mt} - R_{ft}))$
c. Capital Asset Pricing Model (Black) $R_{it} = R_{ft} + \beta_i (R_{mt} - R_{ft}) + \varepsilon_{it}$	Black (1972) suggests that in the CAPM instead of risk-free rate any other measure of risk-free rate can be used. Therefore, the calculation of abnormal returns is same except R_{ft}: $AR_{it} = R_{it} - (R_{ft} + \beta_i (R_{mt} - R_{ft}))$

Table 1 (cont'd)

d. Arbitrage Pricing Theory (APT) $R_i = E(R_i) + b_{i1}\delta_1 + b_{i2}\delta_2 + ... + b_{ik}\delta_k + \varepsilon_i$ $E(R_i) = \lambda_0 + \lambda_1 b_{i1} + \lambda_2 b_{i2} + ... + \lambda_k b_{ik}$	This theory assumes that common K factors influence the returns on all assets. In this model λ_0 is the expected return on an asset with zero systematic risk, λ_j is the risk premium corresponding to jth factor, and b's are the factor betas. Then, abnormal return at each t is: $AR_{it} = R_{it} - E(R_{it})$.
e. Fama-French Three Factor Model $R_{pt} - R_{ft} = a_p + b_p(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + e_{pt}$	In this model, SMB is the difference in returns of small and big firms, and HML is the difference in returns of high and low book-to-market value firms.
f. Control Portfolio	To apply this method, first a portfolio of shares has to be formed to test the effect of an event. Then, another control portfolio is formed with the same risk (i.e., same beta) of the test portfolio. Abnormal returns would be the difference between these two portfolios: $AR_{pt} = R_{pt} - R_{ct}$, where c stands for the control portfolio and p denotes the test portfolio. Therefore, implicitly this approach assumes that all portfolios at the same risk level should earn the same return.
g. Fama-Macbeth Model $R_{it} = \alpha_{1t} + \alpha_{2t}\beta_{it} + e_{it}$	This model is based on the cross-sectional regressions of returns. Starting with shares of different betas, Fama and Macbeth (1973) regress the returns of each month against the beta of that share. After obtaining α, cross-sectional coefficients, from the specified estimation period, abnormal returns are calculated as: $AR_{it} = R_{it} - (\alpha_{1t} + \alpha_{2t}\beta_{it})$.

Table 1 (cont'd)

Other Methods	
a. Firm characteristics in Cross-sectional Models	MacKinlay (1997) explains that given a sample of N observations and M characteristics the model is regressed as follows: $AR_j = \delta_0 + \delta_1 x_{1j} + \ldots + \delta_M x_{Mj} + \varepsilon_j$ where $E(\varepsilon_j) = 0$. To illustrate; Asquith and Mullins (1986) use the size of offerings (as a percentage of the value of total equity) and cumulative abnormal returns as "characteristics" in the regression. Nevertheless, MacKinlay (1997) warns the selection bias problem in case of a "relation between the firm characteristics and degree of anticipation of the event".
b. Abnormal returns as coefficients of the model	According to the classification of Binder (1998) a line of literature uses dummy variables for event periods so that abnormal returns are simply the coefficients of equations. This approach models expected returns as follows: $R_{it} = \alpha_i + \beta_i R_{mt} + \eta_i D_t + \varepsilon_{it}$ where D denotes the one-event period. Therefore, coefficient of D becomes the abnormal return of share i at time t. Multivariate extension of this analysis can be found in Binder (1998).
c. Post-event risk-adjusted performance models	

Table 1 (cont'd)

i) BHAR Approach	The characteristic-based matching approach assumes that you invest in all firms, which experienced the event, and at the end of a specified period you sell these shares. Then, the average multiyear return of this strategy is compared to that of a similar strategy, where now you invest in non-event firms. Nevertheless, this matching based model can suffer from systematic difference between two groups of firms (Kothari and Warner, 2007).
ii) Jensen-alpha approach	In this method, first calendar-time portfolio returns for event firms are calculated. Then, excess returns of this portfolio is used as the dependent variable of the following Carhart (1997) model (either CAPM or three factor F-F Model can be used): $R_{pt} - R_{ft} = a_p + b_p(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + m_p UMD_t + e_{pt}$ where UMD is the difference between the return of past one-year winners and losers.

2.2 Event Studies in Turkey

There have been previous event studies for Turkey testing the impact of different "events" on security prices. Specifically, the effect of news, initial public offerings, rights issues, stock splits, merger and acquisitions in different industries, dividend announcements, dividend payments, rights offerings, investment decision announcements, export connection announcements, cooperation among firms, audit reports, rating score and earnings announcements, financial restructuring applications of distressed firms, political or macroeconomic events and index revisions on stock prices is investigated. Previous studies mentioned the Istanbul Stock Exchange (ISE) since Borsa Istanbul is registered and started operations on April 3, 2013 by consolidating all exchanges in Turkey.

Kıymaz (1999) considers the effect of stock market gossip on prices of stocks operating in manufacturing industry in ISE. It is found that investment decisions based on 614 gossips published in "Economic Trend" magazine over 1996-1997 would not generate any positive abnormal returns whereas the abnormal returns in the pre-publication period of gossip are positive and significant. Therefore, only for the investors who can possess the information initially just before to the publication in the magazine can make profit in ISE (i.e., in contrary to the efficiency of markets) whereas individual investors cannot earn abnormal returns by following a strategy based on published gossip. Yazıcı and Muradoğlu (2001) investigate the impact of security recommendations in the financial press on common stock prices in ISE. Based on 199 buy recommendations, the results show that the recommendations are associated with the positive and significant abnormal returns on the day of publication and preceding days indicating an impact of publications on stock prices and possible abuse of this practice in ISE. Even though the published investment advice does not help small investors earn excess returns, "preferred investors", who can access the information before publication date, can achieve superior abnormal returns by front-running.

In another study by Erdogan et al. (2010), the analyst recommendations are evaluated in ISE over 1993-2005. Neither the long-run abnormal returns of a trading strategy purchasing (selling) stocks with the most (least) favorable recommendations nor the stock recommendations could support the stock picking ability of analysts. Only some specific brokerage houses are found successful at stock picking.

Considering the performance of public offerings, Kıymaz (1997b) investigates the performance of initial public offerings (IPO) of 39 financial institutions over 1990-1995 in ISE. Over 30-month event window following the IPO, 11 per cent positive abnormal return is observed. In another paper by Kıymaz (1997a), 10.8 per cent market adjusted returns are observed on the first trading day of 25 firms in ISE for 1996. Kıymaz (2000) also investigates the IPO performance of 163 firms over 1990-1996, and find underpricing on initial trading day on average of 13.1 percent. The size of issuer, rising stock market between the date of public offering and first trading day, institutional ownership, and self-issued offerings are referred as significant determinants of underpricing. In another study by Ayden and Karan (2000), underpricing in IPOs is also examined for 70 IPOs over 1992-1995. Nevertheless, no evidence is found to support significant cumulative abnormal returns over 36 months following the IPO.

Teker and Ekit (2003) examine the performance of 34 IPOs in 2000 in ISE and observe positive abnormal returns over the first two days of IPOs. Yalçıner (2006) finds that the average returns of stocks offered publicly at the ISE on the first trading dates have a positive value (i.e., underpricing) over 1997-2004, indifferent from the IPO method and IPO prices. Erpek (2006) also considers the 30-days performance of IPOs of 9 incorporated companies in 2005. The results indicate that over 2 days following the IPO, there is a significant abnormal return over the market (ISE-100) indicating underpricing and inefficiency in the ISE. Ayaz (2006) considers IPOs of 245 firms over 1990-2004, and three-year average cumulative abnormal return is calculated 17.49 per cent supporting the underpricing argument.

Bildik and Yılmaz (2008) also find evidence of underpricing in the IPOs over the period of 1990-2000. The results from the IPOs of 234 firms indicate an average abnormal first day return (5.94%) and underperformance up to three-year holding period in the ISE. On average, IPOs are found to underperform the market by 84.5% over this holding period. On the other hand, Altan and Hotamış (2008) could not find any evidence for or against underpricing in initial public offerings over 2000-2006 in ISE based on abnormal daily/weekly/monthly returns. Tükel (2010) also considers the underpricing in the context of asymmetric information by using the IPO data of 42 stocks in ISE over 2000-2007. First trading day returns are found 10.94 per cent and cumulative abnormal returns increases from 27.95 per cent (for the first month) to 39.74 per cent at the end of 36^{th} month following the IPO.

Otlu and Ölmez (2011) examine the performance of 53 stock certificates offered to public for the first time in ISE over 2006-2011.

Following the public offering, the evaluation of 21-day price performance indicates that an investor, who purchased the certificate at the IPO price, may earn 6.99 per cent average abnormal return by selling at the first-trading day. In a recent study by Kaya (2012), short term performance of 32 IPOs in ISE over January 2010-June 2011 is considered. Nevertheless, the results do not support the previous findings: for 15 of 32 IPOs negative returns are observed after the first trading day. One possible explanation is indicated as the price margin regulations in ISE.

Akarim (2013) also considers the impact of international cross listings on risk and return of the American Depository Receipts (ADRs) issued by Turkish companies' stocks. Based on 26 stocks' data, negative abnormal returns are found on the listing day where the variances of the most stocks increase following the listing.

In addition to the IPOs, the effect of right issues and stock splits on returns is investigated by several papers. Özer and Yücel (2001) consider the impact of capital increases through rights issues and stock splits over 1989-1997 on stock prices. Based on the results at the day and before the rights issues significant positive abnormal returns are observed, and a strategy of buying before the stock splits and selling following 2 days after the split creates positive abnormal returns. On the other hand, no significant difference between rights issues and stock splits is indicated. Adaoğlu (2001) examines the impact of the "unsweetened" and "sweetened" rights offerings[6] during the announcement and subscription periods over 1986-1999. Based on

[6] Plain right offerings are called as "unsweetened" and rights offerings accompanied by simultaneous distribution of bonus shares are called as "sweetened" in the Turkish capital market.

the negative (positive) market reaction to "unsweetened" ("sweetened") rights offerings during the announcement period, and positive reaction to both "unsweetened" and "sweetened" rights offerings, signaling and improved liquidity hypotheses are supported. Also, Cukur and Eryigit (2007) investigate the effect of bonus share issues on closed-end mutual funds' returns where no abnormal returns over event windows (-10,+10) were found between 2000 and 2005.

In another study by Yolsal (2011), the impact of splits on returns for the shares included in ISE-30 Index is examined over 2005-2011. Out of 159 stock splits, a sample of 45 splits is selected randomly (once). Based on both parametric (t-tests) and non-parametric tests (rank test), stock splits do not create any abnormal returns referring the semi-strong form efficiency of ISE.

The impact of the mergers and acquisitions on stock performance has also been investigated for Turkey. In a study by Çukur and Eryiğit (2006) the effect of merger and acquisitions (M&A) in banking industry in 2005 on stock prices is examined. The results indicate that the announcements of M&A plans produce positive and significant abnormal returns whereas the realizations of M&As do not lead significant abnormal returns. Solakoglu and Orhan (2007) investigate the impact of M&As on firm value for the Turkish target and acquiring firms over 2003-2006. In line with the previous findings, Solakoglu and Orhan (2007) claim that target firms realize larger increase in value than acquirer firms, and increase in the cumulative abnormal returns before the announcement date refers information spillover.

Taşcı (2008) also considers the M&As of bank listed at ISE over 2004-2008. Based on the cumulative abnormal returns over event window (-3,+3), no significant abnormal returns are found whereas significant negative abnormal returns are observed over the post-event period. Additionally, overreaction to the announcement of M&As is indicated in contrary to the semi-strong form of efficiency at ISE.

Yörük and Ban (2006) examine the impact of mergers on the stock prices of firms operating in food industry. Based on 8 mergers in food industry over 1997-2004 in Turkey, they find no excessive profit over long-term, but observe abnormal returns over (-5,+5) event window. Kırkulak Uludağ and Demirkaplan Gülbudak (2010) also investigate the impact of mergers of non-financial firms on stock prices over 1997-2006. In line with prior findings, an increase before the merger announcements is observed followed by a decrease with the merger announcement and during post-merger period.

Hekimoğlu and Tanyeri (2011) consider the effect of mergers of non-financial Turkish firms on stock prices over 1991-2006. Around 3 day event window around the merger announcement, 8.56 per cent cumulative abnormal returns is observed for Turkish targets when the bidders purchase control rights. These comparatively low cumulative abnormal returns (for the US around 20 per cent and for Europe around 10 per cent indicated) are explained by the possible uncertainty in dates of announcements, and the impact of differences among countries' legal framework and competitive environment on the distribution of value created by the merger to buyers and target. Akben-Selcuk and Altiok-Yilmaz (2011) also examine the impact of M&A deals on the performance of acquirer Turkish companies. Based on 62 companies involved in M&A over 2003-2007, the results over 10-day and

7-day event windows support that the acquirers are negatively affected by M&A activities, but over shorter event windows the findings could not be confirmed.

In a recent study by Meder Çakır and Gülcan (2012), the effect of mergers and acquisitions of 81 non-financial firms on stock returns is examined over 2005-2009, and based on (-5,+5) and (-20,+20) event windows significant cumulative abnormal returns are observed especially before the announcements.

Oelger and Schiereck (2011) examine the impact of cross-border takeover announcements for Turkish shareholders. Based on event study results from 112 acquisitions over 1992-2010, cumulative abnormal returns over (-10,+10) event window is found significant even dividing the sample into two sub-samples: "national" and "cross-border" mergers. Focusing on the cross-border transactions, cumulative abnormal returns (CARs) of acquirers for transactions into Asia and Europe are compared, and it is found that the Turkish capital market is not in favor of takeovers into Asia while the effect for transactions into Europe is neutral.

Apart from these studies on merger and acquisitions, Onar and Topcu (2011) suggest employing Bayesian Belief Network (BBN) by extending the event study methodology in order to observe the interactions among events. In order to apply BBN, 50 strategic decisions (such as mergers, acquisitions, joint ventures) over 1996-2006 are considered. After defining the important factors by event study with CARs, casual relationship between the factors is evaluated.

Another important linkage between dividend announcements and security prices is also questioned for the ISE. Aydoğan and Muradoğlu (1998) examine the impact of announcements of implementations of rights issues and stock dividends on stock prices in ISE. Based on 109 rights offerings-stock dividend announcements over 1988-1993, neither board meeting nor the actual implementation of stock dividends-rights offerings is found to be significant. Together with the event study methodology, non-parametric tests (sign and rank tests) are employed, but non-parametric tests are not found suitable for this study for two reasons. First, the sensitivity of the length of event window for rank test is considered since in their study event window is significant up to 18 days. Second, the outperformance of sign test in case of extreme abnormal returns is indicated whereas in their study low abnormal returns were detected.

In another study by Muradoğlu and Aydoğan (1998), the reaction to the implementation of stock dividends and rights offerings is considered over an extended time period (1988-1994) for a total of 513 events of 169 companies. Based on both t-test and rank test results, only for the sub-period of 1993-1994 significant price reactions to such information is indicated for a thirty day event window. Following this study, in another study by Muradoğlu and Aydoğan (2003) price reactions to the announcements of stock dividends and rights offerings are analyzed considering different time periods and investor mix changes. Based on all stocks listed at the ISE over 1988-1994, significant and persistent price reactions are observed only for the 1993-94 sub-period (even confirmed with the non-parametric tests that are employed as a cure for the thin trading during the initial phases of the ISE).

This pattern is tried to be explained with the improved quality and quantity of financial information during the latest periods, and the changing investor profile from institutional to individual investors during the 1993-1994 period: individual investors with higher number of shares traded and the small orders executed at ISE.

Batchelor and Orgakcıoğlu (2003) consider the effect of stock dividends on company value via GARCH process with event –related intercept terms capturing induced changes in the volatility of stock prices. They employ a regression model to estimate the coefficients for the abnormal returns in the different windows: (-30, -11), (-10,-1), t=0, (+1,+10), (+11,+30), and use these coefficients in a GARCH process. Based on results over 1990-1994, the change in returns before a pure stock dividend payment is estimated 0.8089 where the increase in returns due to a cash dividend payment is also found significant. Besides, the prices are found exceptionally volatile on the stock dividend payment date. This change in volatility also continues after the payment date, but as a reaction to the volatility around the dividend date (i.e., explained in terms of conditional heteroscedasticity).

Yılmaz and Gulay (2006) examine the impact of cash dividend payments on stock returns and trading volumes in ISE over 1995-2003. Their results indicate that prices start to increase during a few sessions before cash dividend payments made, and prices fall less than the amount of change in dividend payments on ex-dividend days. Therefore, the findings support profitable trading opportunities based on before and after dividend payment dates.

Bayazıtlı et al. (2008) consider the impact of dividend payment announcements on stock prices of construction industry firms at ISE in 2005. The results from 16 stocks indicate significant positive cumulative abnormal returns (%2.02) over (-10,+10) event window in contrary to the semi-strong form of efficiency. In another study by Kadioglu (2008), the effect of cash dividends on share prices in ISE is observed over (-5,+5) event window for 330 events of 88 companies from 2003 to 2007. Kadioglu (2008) finds significant negative relationship between cash dividend announcements and abnormal returns after the event date whereas there is no relationship prior to announcement. Besides, the adjustment of prices to new information continues from the event date to 15 days following the event date.

Günalp et al. (2010) use 321 cash dividend announcements of relevant 83 companies in the ISE over 2003-2007 and find the information content of the dividend announcements (i.e., negative relationship between cash dividend and abnormal returns after announcement) whereas there is no relationship prior to the announcement (i.e., no information leakage). Besides, it is found that starting from the announcement date, the adjustment of prices continues at least 15 days. In another study by Altiok-Yılmaz and Akben-Selcuk (2010), market reaction to dividend change announcements is analyzed in ISE over 2005-2008. Based on 184 announcements, the results indicate that in line with the signaling hypothesis prices increase (decrease) as dividend increases (decreases), and do not react to unchanged dividends.

Kaderli and Demir (2009) investigate the impact of investment decision announcements in 2008 on stock prices in ISE. The results of 26 stocks from 5 sectors indicate that these announcements have positive impact on stock prices violating the semi-strong form of efficiency. Kaderli (2007) also states that it is possible earn positive abnormal returns based on export connection announcements of firms in ISE. Based on only 3 announcements in 2005, even over (-20,+20) event window positive cumulative abnormal returns are observed. Bekçioğlu et al. (2004) investigate the impact of cooperation among firms on stock prices in ISE by considering three announcements of three stocks in 2003. Positive and significant cumulative abnormal returns are found to be violating the semi-strong form of efficiency in ISE.

Aygören and Uyar (2007) also consider the effect of audit reports of 101 firms on stock prices in ISE over 2004-2005. Considering 4 types of audit reports announced to public (positive, conditional, avoidance to comment, and negative), the results indicate that positive and conditional types of audit reports are differently perceived by the investors, and significant abnormal returns over (-10,+10) event windows violate the semi-strong form of efficiency in ISE.

In another study by Sakarya (2011), the relationship between the rating score announcement of the companies, whose stocks are incorporated into the ISE Corporate Governance Index in 2009, and stock returns is analyzed. Contrary to the semi-strong form of efficiency, a positive correlation is found between the announcement of favorable corporate governance rating score and stock returns. Bozcuk (2010) also investigates the price reaction to corporate governance rating announcements in the ISE over 2006-2009. Based on 20 events (where the events are the issue date of the corporate governance rating report by the rating agencies), 0.5 per cent average abnormal return is found on announcement day followed by positive average cumulative abnormal returns for the next 18 days.

Kaminsky and Schmukler (2002) investigate the impact of changes in sovereign debt ratings on stock returns for 16 emerging markets including Turkey over 1990-2000. For 103 changes in ratings and outlook, the dollar "stock spreads" between emerging markets stock prices and the S&P 500 US stock market index are calculated. The results indicate that upgrades (downgrades) occur when the markets are rallying (collapsing). Kaminsky and Schmukler (2002) explain this phenomenon as follows: "rating agencies provide bad news in bad times and good news in good times, reinforcing investors' expectations" referring a contribution to the insatiability in emerging financial markets.

In addition to the reports and ratings, Erdogan and Yezegel (2008) also consider the impact of announcement of no new news on stock prices in ISE over 1998-2004. Specifically, Oral and Yezegel (2008) focus on the instances where ISE requested information from firm management and firm's replies stating the absence of news. Correspondingly, the event date is chosen to be the day that market participants become aware of both ISE's request and the firm's response, the event date is the day that the firm's response to ISE's request is published and publicly made available through ISE's daily report. Based on results, prices continue to decrease even though there is no news published following large negative price changes. Even though there is partially reversal in prices following the positive price changes, there is no complete price reversal.

Kurtay (2007) investigates the impact of insider trading in ISE over 2004-2006. The findings indicate that insiders are successful on timing of transactions especially on the sell side. Muslumov (2008) also examines the impact of insider trading on stock price volatility in ISE over February 2005-June 2007. Based on results, sell positions, trades of the traders more related with the company, larger trades, trading in smaller stocks, and trading with contrarian strategies cause more volatility following the trading. Dogu et al. (2010) also support the view that all insider groups leak information to the market over 2005-2007 by the analysis of 4,564 observations related to 213 companies listed in ISE.

Tahaoğlu and Güner (2011) investigate the return performance of insiders of companies listed on ISE from their open market transactions and that of uninformed investors following insider transactions announced to the public. Based on 9163 observations from 216 companies over 2007-2008, it is found that affiliated shareholders can earn above market returns from their transactions (especially from sales) against the semi-strong or strong form efficiency.

Özkanlı (2011) examines the effect of public announcements about financial restructuring applications of distressed companies on returns. Based on one selected textile firm's 43 public announcements over 2002-2008, positive reaction to public announcements is confirmed only for this firm.

Considering the earning announcements, Odabasi (1998) investigates the stock return reaction to earnings announcements in ISE for 603 semi-annual and annual earnings announcements of 92 firms over 1992-1995. Separating good and bad news, average abnormal returns on announcement days are found significantly different from zero for each sub-sample referring that earnings announcements possess informational value. Aksoy (2008) analyses the information content of inflation adjusted financial statements, and tests the impact of financial statement announcements on stock returns. The simple market model is used by using the last 100 days before the event window, but the coefficients of the model are gathered from another database. Based on results from non-financial firms, in 2004 (contrary to 2002) there exists abnormal returns over the event window.

Another different use of cumulative abnormal returns is the comparison of investment strategies. Yucel and Taskin (2007) support the overreaction hypothesis with substantial price correction in ISE by using monthly returns over 1992-2005. Therefore, contrarian strategies are found profitable for one-year, two-year and three-year portfolio formation periods. On the other hand, Mehdian et al. (2008) could not find any evidence supporting the overreaction hypothesis whereas uncertain information hypothesis (i.e., corrective process of positive returns following favorable news) is affirmed over 1997-2004.

Doğukanlı et al. (2012) also test the overreaction hypothesis and contrarian investment strategies in ISE. Over 1, 2, 3, 6, 12, 24 and 36-month periods for the stocks included in ISE-100 index over 1998-2008, winner and loser portfolios are formed, and the overreaction hypothesis and effectiveness of the contrarian strategies are supported contrary to weak form efficiency. Erzurumlu (2011) also tests and supports the overreaction hypothesis on the ISE-100 index by considering the investor reaction to unexpected news. Based on index changes over 1988-2010, the events (trigger points) are defined by employing GARCH model. A possible implication of results is indicated such that buying losers in ISE-100 may generate superior returns for investors.

Considering the political events, Mandacı (2003) investigates the impact of general elections on market index, ISE-100. Based on the (-15,+15) event window, it is found that following only some elections there are abnormal returns in the market. The results could not be generalized for all elections in conjunction with the uncertainty in political environment and macroeconomic conditions. Aktaş and Oncu (2006) also consider the impact of a major political event, specifically March 1, 2003 (when the Turkish Parliament rejected the highly controversial bill that allows the deployment of US Troops in Turkey) on prices of 50 stocks listed in ISE-50 index as of March 2003. On the first trading day after the rejection of the motion, historical of betas are estimated by using simple market model (with 60 days, 120 days and 240 days of returns). Based on OLS estimates, historical betas are found highly significant exploratory variables for the percentage decline of stock prices on the day of sharp market fall. By using abnormal returns on the day following the event date (t=1), two portfolios (one with stocks having lower abnormal returns, and one with reminder stocks with higher abnormal returns) are formed, but the difference between portfolio returns are found insignificant referring no sign for underreaction or overreaction.

In order to examine the impact of the European Union Membership related events on stock market, Eryigit (2007) considers abnormal cumulative abnormal returns on 17 sector indices for six important dates over 2000-2005. Different than many studies considering the returns on stocks, in Eryigit

(2007), the significance of cumulative abnormal returns of an index over the event window is tested. Based on results, there is no uniform reaction pattern to the announcements and developments shared by all sectors.

Penas and Tumer-Alkan (2010) consider the impact of indicators of financial fragility in Turkish banking sector (such as maturity mismatches, currency mismatches) on stock returns. The results from 12 commercial banks over 1995-2001 indicate that shareholders react negatively to these indicators.

In another study by Bildik and Gülay (2008) the relation between the revisions realized in ISE-30 and ISE-100 indices and the returns is considered in the period 1995-2000. Based on results, stocks included in an index demonstrate significant positive abnormal returns on the announcement day, and vice versa.

Another application area of event study methodology has been the macroeconomic announcements. Ağcaer (2003) examines the effects of the Central Bank foreign exchange auctions and direct interventions on the level and volatility of US $/TL exchange rates using E-GARCH and event study analysis over 2001-2003. By using the data from the Central Bank (CB), the changes in the foreign exchange over (-10,-1) and (+1,+10) are compared with t-test. Based on three auctions and five direct interventions, it is concluded that CB foreign exchange auctions and direct interventions have a favorable impact on both the level and volatility of exchange rates. Akıncı et al. (2005) also investigate the impact of foreign exchange interventions of CB on the exchange rates as well as the volatility, but by comparing a new methodology, a time-varying parameter model, with the event study method over 2001-2003. Considering 11 interventions before and after 5 days from the event date, both methodologies indicate that purchase interventions during the second half of 2003 seem to be effective. In another study by Duran et al. (2010), the impact of monetary policy is investigated by employing both heteroscedasticity-based generalized method of moments (GMM) and event study. Based on results, a rise in the policy rate causes an appreciation of domestic currency, increase in interest rates, and decline in stock prices, especially for financial sector firms. Nevertheless, the study does not provide any details about the event study methodology. Duran et al. (2010) also consider the effect of policy rates on stock prices separately, and negative impact of increase in policy rate is supported without giving the details of method.

Ulku (2001) examines the relation between commencement of the 2000-2003 disinflation program and stock market. Based on weekly autocorrelations starting from September 1999 ending on September 2000, the overreaction in the ISE-100 index around the start of program is found. Nevertheless, this study follows autocorrelations based on regressions instead of standard event study methodology. Kocyigit and Kilic (2008) investigate the impact of VAT (value added tax) regulations to be implemented in the leasing sector in 2008 on the returns of public leasing sector shares. Based on the results from 7 companies, the cumulative abnormal returns are found significant only between the 38th and 40th days before the event, but no other windows.

Mutan and Topcu (2009) focus on the impact of various 10 events (including military, economic, political events, terrorism, and natural disaster) on ISE-100 index over 1990-2009. For each specific event, both the cumulative abnormal returns and the persistence of the impact are interpreted. In another study by Chesney et al. (2010) the impact of 77 terrorist events that occurred in 25 countries (including Turkey) on stock, bond and commodity markets is examined over 1994-2005. Each terrorist attack is classified based on its type, target, damage and place of occurrence. By adopting three methodologies (event study, non-parametric and GARCH approaches), the differences in various markets and industries are compared. From the point of portfolio diversification, investment in US Government bond and banking stock indices are referred as "safe" whereas investing in gold and commodity markets are indicated as "not always the best hedge". Besides, comparing the robustness of results non-parametric approach is found as the most appropriate method. Arin et al. (2008) also consider the impact of terrorism on six financial markets by using the bivariate VAR-GARCH[7](1,1)-in mean model, and support a statistically significant causality effect both in mean and variance, especially in emerging markets.

Related to the macroeconomic data, Tokel and Yucel (2009) examine another aspect: impact of announcements of policy interest rates and consumer price data on online data access statistics by using the Central Bank. Based on average data access statistics, both events have effect on the data access behavior.

In addition to the political, economic or finance related events, impact of other events on capital markets is also investigated. Aygören et al. (2008)

[7] VAR means vector autoregression and GARCH is used for generalized autoregressive conditional heteroskedasticity.

consider the impact of performances of football teams on stock returns in ISE where the event date is defined as the date of derbies and European football matches of four biggest teams of Turkey over 2001-2007. Based on (-1,+1) event window for 87 derbies and 90 European matches, in all European football matches significant abnormal returns are observed whereas for derbies only in case of defeats significant abnormal returns are indicated. In another study by Demir and Danis (2011), the stock price reactions of three biggest Turkish soccer clubs to game results are examined. The results from 2008/9 soccer season indicate an asymmetric reaction to both wins and losses whereas winning in a European Cup does not affect at all.

Bolak and Suer (2008) measure the effect of Marmara earthquake (dated August, 17, 1999) on the stock returns in ISE. Based on results from 20 (banking and insurance) firms, for each insurance firm significant negative abnormal returns are observed just after the earthquake whereas this impact is not significant for all banks.

Apart from these event studies conducted for Turkey, Gümüş (2008) applies BW methodology to the ISE by using 50 samples each with 20 securities (whereas in BW studies 250 samples each with 50 securities were formed). Following BW, (-5,+5) is used as the event window and (-244,-6) as the estimation window using daily returns. Comparing different methodologies (mean adjusted returns, market adjusted returns and simple market model) with certain and uncertain event dates over 1997-2007, it is concluded that, similar to BW, mean adjusted returns perform best. Nevertheless, other issues such as the calculation method of returns, sample size, length of event window, clustering problem are not considered in this elementary study. Especially, the examination of raw data that is widely discussed here in Chapter 3 is not mentioned by Gümüş (2008). Oran and Soytas (2008) also follow a simulation based method to examine the characteristics and stability of individual stock and portfolio betas in ISE. For individual stocks random 500 event dates are created, and for each date a stock is sampled with replacement. Basically the simple market model with ISE-100 index over 500-workday window around the event date is regressed. Since the aim of the paper is not the analysis of the effect of random events, the results of regressions are not presented.

In the studies relevant to Turkish stock market (studies with a model and sufficient information are summarized in Table 2), it is generally seen that the results generally indicate the violation of semi-strong form of efficiency in Turkish Stock Market. Since this thesis does not focus on the tests of efficiency, the most important points from the evaluation of all studies mentioned can be summarized as follows:

- Number of the events considered can vary significantly. Especially in some of the studies (such as Kaderli (2007) and Özkanlı (2011)) the number of events is too low to make a generalization about the entire market.
- 32 out of 71 studies use only market adjusted studies, 25 articles apply only simple market model, and 1 study employs only mean adjusted returns. In 4 studies only CAPM is used to calculate abnormal returns. Also, only in 1 study (Tahaoğlu and Güner, 2011) Fama-French Three Factor Model is used.

Only in 2 studies (Gümüş, 2008; Özkanlı, 2011) mean adjusted, market adjusted returns and simple market model are used together. Indeed, Gümüş (2008) is a simulation based study that must be separately considered from other event studies. Therefore, only Özkanlı (2011) examines actual events with three models.

In only 1 study (Erpek, 2006), both market adjusted and CAPM are employed. On the other hand, 1 study (Erdogan et al., 2010) employs simple market model, but also uses CAPM for the long term performance.

In 3 studies returns on index are considered only, so that there is no model for these papers. For 1 study, the details about model could not be found in the article.

Except Gümüş (2008), in none of the studies the choice of the underlying performance model is the main concern of study.

- In 54 out of 71 studies (including 8 studies applying ISE-Composite Index), ISE-100[8], which is named as BIST-100 after April 3, 2013, is selected as the market index. In 4 studies, ISE-TUM[9] (ISE-ALL or BIST-ALL with its name after April, 2013) is selected whereas in only 1 study S&P 500 Index is used considering the multi-country analysis. On the other hand, in 9 of the studies the market index is not indicated

[8] ISE-100 index is used as the main index for Borsa Istanbul Equity Market. It is the successor of the Composite Index which was introduced in 1986 including the stocks of 40 companies and was in time limited to the stocks of 100 companies. It consists of 100 stocks which are selected among the stocks of companies listed on the National Market and the stocks of real estate investment trusts and venture capital investment trusts listed on the Collective Products Market. BIST 100 index automatically covers BIST 30 and BIST 50 stocks.

[9] The index consists of the stocks of companies traded on all Borsa Istanbul markets except Investment Trusts.

in detail. In only 1 study, returns on both ISE-100 and ISE-ALL are considered.

- In only 11 studies both parametric and non-parametric tests are applied indicating a gap in this area considering the non-normality of stock returns.

Therefore, the summary of previous studies in the Exchange show that the studies generally choose ISE-100 (BIST-100) and market adjusted returns, without basing the choice of model, mainly focusing on the parametric tests. In general, the studies prefer to rely on one type of model to calculate the abnormal returns.

Table 2. Articles using Event-study Methods with Turkish Data

Article	N (Number of events/ observations)	Countries	Model	Index	Event Window (in days otherwise stated)	Estimation Window (in days otherwise stated)	Tests
Adaoğlu (2001)	838 rights offerings	Turkey Database: ISE Publication named "ISE Companies: Capital, Dividend and Monthly Price Data 1986-1999"	Simple market model	ISE-100	(-5,+10)	(-200,-21)	t-test
Akarim (2013)	26 cross-listed stocks	Turkey Database: Finnet (for prices) and Central Bank (for index)	Simple market model	ISE-100	(-15,+15)	(-250,-100)	t-test
Akben-Selcuk and Altiok-Yilmaz (2011)	62 companied involved in M&A activities	Turkey Database: ISE	Simple market model	ISE-index (no info)	(-5,+5) and (-3,+3)	Not indicated	t-test
Aksoy (2008)	72 financial statement announcements of 36 firms that	Turkey Database: ISE (for financial statement and event dates),	Simple market model	ISE Comp. Index	(-10,+10)	(-110,-11)	t-test

Table 2 (cont'd)

	existed both in 2002 and 2004	Istanbul Bilgi Iletisim Sistemleri Inc. (IBS) database www.analiz.com (for the coefficients of simple market model)					
Aktaş and Oncu (2006)	50 stocks listed in ISE-50 index	Turkey Database: Finnet Database	Simple Market Model	ISE-100	(0,4)	(-16,-75), (-16,-135), (-16,-255)	t-test
Altan and Hotamış (2008)	84 initial public offerings	Turkey Database: ISE	Market adjusted returns	ISE-100	Abnormal return at t=1 (first day, week and month)	-	t-test
Altiok-Yılmaz and Akben-Selcuk (2010)	184 dividend change announcements of 46 companies	Turkey Database: daily bulletins of ISE	Simple market model	ISE-100	(-1,+1)	(-360,-6)	t-test
Ayaz (2006)	245 IPOs	Turkey Database: ISE	Market adjusted returns	ISE-Comp. Index	36 months following the IPO	-	t-test
Ayden and Karan (2000)	70 IPOs	Turkey Database: Datastream	Market adjusted returns	ISE-100	36 months following the IPO	-	t-test

Table 2 (cont'd)

Aydoğan and Muradoğlu (1998)	109 rights offerings-stock dividend announcements	Turkey Database: Survey to CEOs to obtain event dates, Capital Market Board (to obtain prices)	Market adjusted returns	ISE-Comp. Index	(-30,+30)	-	t-test, rank and sign tests
Aygören and Uyar (2007)	Audit reports of 101 firms	Turkey Database: ISE and ISE daily bulletins	Simple Market Model	ISE-100	(-10,+10)	(-161,-11)	t-test
Aygören et al. (2008)	87 derbies and 90 European football matches of 4 biggest teams	Turkey Database: ISE and football teams' web sites	Simple market model	ISE-100	(-1,+1)	(-251,-1)	t-test
Batchelor and Orgakcıoğlu (2003)	110 announcements of 20 stocks	Turkey Database: ISE	CAPM	No info in the article	(-10,+10)	Full data is used to estimate CAPM.	Event related GARCH model
Bayazıtlı et al. (2008)	16 stocks	Turkey Database: ISE (for announcements), Garanti Bank (www.paragaranti.com for daily returns)	CAPM	ISE-100	(-10,10)	Not indicated in the article	t-test

Table 2 (cont'd)

Bekçioğlu et al. (2004)	3 announcements of 3 stocks	Turkey Database: www.bigpara.com	Market adjusted returns	ISE-100	(-10,10)	-	t-test
Bildik and Gülay (2008)	204 inclusions to index and 180 exclusions from the index	Turkey Database: ISE Official Daily Bulletins	Market adjusted returns	ISE-100	(-10,+10) (also sub-windows are examined such as pre-/post-ann.)	-	t-test, signed-rank test and Wilcoxon sign
Bildik and Yılmaz (2008)	IPOs of 234 firms	Turkey Database: ISE	Market adjusted returns	ISE-100	1, 2, 3, 4, 5 trading days, 1, 3, 6, 12, 24, 36 months following the IPO	-	Parametric (t-test) and Non-parametric tests (sign and Wilcoxon signed rank)
Bolak and Suer (2008)	20 firms	Turkey Database: ISE	Simple market model	ISE-100	(+1,+30)	(-250,-1)	t-test
Bozcuk (2010)	20 corporate governance rating report announcements	Turkey Database: ISE	Simple market model	No info	(-5,0), (-2,0),(0,2) and (0,5)	Not indicated	t-test

Table 2 (cont'd)

Chesney et al. (2010)	77 terrorist events from 25 countries	25 countries Database: Datastream (for financial market indices)	Mean adjusted returns	N/A (only impact on indices)	(0,+5)	(-11,-30)	CDA and non-parametric test (local polynomial regressions)
Cukur and Eryigit (2006)	5 stocks	Turkey Database: Borsa Istanbul Research Department	Simple market model	ISE-100	(-10, 10)	(-159,-10)	t-test
Cukur and Eryigit (2007)	22 events	Turkey Database: ISE	Simple market model	ISE-100	(-10,+10)	(-110,-11)	t-test
Demir and Danis (2011)	Event number changes per soccer club	Turkey Database: Euroline (platodata.com.tr) and mackolik.com (for soccer game results)	Simple market model	ISE-100	t=1 (first trading day after the game)	Not indicated	t-test
Dogu et al. (2010)	4564 observations of 213 firms	Turkey Database: ISE	Simple market model	ISE-100	(-15,+15)	(-250,-16)	Z-statistics
Doğukanlı et al. (2012)	Stocks included in ISE-100 index	Turkey Database: ISE	Market adjusted returns	No info	CARs over 1, 2, 3, 6, 12, 24 and 36-month periods	-	t-test

Table 2 (cont'd)

Erdogan and Yezegel (2008)	592 instances where ISE requested information from firm management	Turkey Database: ISE	Simple market model	ISE-100	(-5,0)	(-300,-46)	Parametric (Patell, portfolio time-series standard deviation and skewness corrected transformed normal tests) and non-parametric tests (sign and rank tests)
Erdogan et al. (2010)	10,147 analysts' recommend.	Turkey Database: I/B/E/S database (for recommendations), ISE, Global Financial Database (for bill rates)	Simple market model (CAPM for long term performance)	ISE-100	(-20,+20)	(-300,-46)	Patell, portfolio time-series standard deviation and skewness corrected transformed normal tests and sign test
Erpek (2006)	IPOs of 9 incorporated companies	Turkey Database: ISE	Market adjusted returns and CAPM	ISE-100	(+1,+31)	- (For CAPM, (-91,-1) estimation window)	t-test

Table 2 (cont'd)

Eryigit (2007)	6 important days related to the EU membership	Turkey Database: Plato Data	Simple market model	No info	9 different event windows over (-20,+20)	Estimation period is defined as 150 days.	t-test
Erzurumlu (2011)	42 trigger points for ISE 100 and 23 points for ISE 30	Turkey Database: ISE	Index changes are considered.	ISE-100	(0,+30)	-	t-test
Gümüş (2008)	Application of BW (50 samples each with 20 securities)	Turkey Database: ISE	Mean adjusted, market adjusted returns and simple market model	ISE-100	(-5,+5)	(-244,-6)	t-test, sign and rank tests
Günalp et al. (2010)	321 dividend announcements of 83 stocks	Turkey Database: ISE	Market adjusted returns	ISE-TUM (ISE-ALL)	(-5,-1), (-2,-1), 0, (0,1), (0,2), (0,4), (0,10), (0,15)	-	Regression analysis with CARs
Hekimoğlu and Tanyeri (2011)	125 merger announcements	Turkey Database: Securities Data Company (SDC), Dow Jones Factiva, Market	Simple market model	ISE-100	(-30,+30)	(-282,-31)	CDA

Table 2 (cont'd)

		Line Financial Deals, Borsa Istanbul Company News, Datastream (for prices and indices data)					
Kaderli (2007)	3 announcements of 3 stocks	Turkey Database: ISE	Market adjusted returns	ISE-100	(-5,5), (-10,+10), (-20,20)	-	t-test
Kaderli and Demir (2009)	26 stocks from 5 sectors	Turkey Database: Finnet and ISE	Market adjusted returns	ISE-100	(-5,5)	-	t-test
Kadioglu (2008)	330 cash dividend announcements	Turkey Database: ISE	Market adjusted returns	ISE-ALL	(-5,+5)	-	t-test
Kaminsky and Schmukler (2002)	103 domestic-country rating and outlook changes (56 upgrades and 47 downgrades) For Turkey, 6 events (3 upgrades and 3 downgrades)	16 emerging markets: Argentina, Brazil, Chile, Colombia, Indonesia, Malaysia, Mexico, Peru, the Philippines, Poland, the Republic of Korea, the Russian	Market adjusted returns	S&P 500 US stock market index	(-10,+10)	-	N/A (For panel regressions, tests are conducted)

Table 2 (cont'd)

		Federation, Taiwan, Thailand, Turkey, Venezuela Database: JP Morgan's Emerging Markets Bond Index (EMBI) for sovereign bond yield spreads, Bloomberg and Datastream (for stock prices, US interest rates and credit ratings)					
Kaya (2012)	32 IPOs	Turkey Database: ISE and Euroline (for prices), Central Bank and Turkish Statistical Institute (for risk free rate)	CAPM	ISE-100	1 day, 2-4 days, 1 week, 1, 3 and 6 months following IPO	182 days returns of similar firms (before IPO)	t-test
Kırkulak Uludağ and Demirkaplan Gülbudak (2010)	37 mergers	Turkey Database: ISE (merger announcements and financial	Market adjusted returns	ISE-100	5 days and 12 months before and after the merger	-	t-test

Table 2 (cont'd)

		statements) and Analiz Software Co. Database (price data)					
Kıymaz (1997b)	39 initial public offerings	Turkey Database: ISE	Market adjusted returns	ISE-Composite Index	Over 1-30 months	-	t-test
Kıymaz (1997a)	25 initial public offerings	Turkey Database: ISE	Market adjusted returns	ISE-Composite Index	Over 1-10 days	-	t-test
Kıymaz (1999)	614 gossips about manufacturing firms	Turkey Database: "Ekonomik Trend" Weekly Magazine	Simple Market Model	ISE-100	(-30,30)	(-210,-31)	t-test
Kıymaz (2000)	163 initial public offerings	Turkey Database: ISE	Market adjusted returns	ISE-Composite Index	Over 1-8 days	-	t-test
Kocyigit and Kilic (2008)	7 companies in leasing sector	Turkey Database: paragaranti.com	Simple market model	ISE-100	(-43,+43)	Indicated as 127 days	t-test
Kurtay (2007)	6650 transactions	Turkey Database: ISE	Simple market model	ISE-100	(-20,+20)	Yearly estimations	t-test

Table 2 (cont'd)

Mandacı (2003)	Impact of 4 elections on ISE-100	Turkey Database: TBMM.com (for elections) and Borsa Istanbul	Returns on index is used	ISE-100	(-15,15)	(-360,-15)	Z-test, t-test
Meder Çakır and Gülcan (2012)	M&As of 81 firms	Turkey Database: Ernst & Young M&As Report	Market adjusted returns	ISE-100	(-5,+5) and (-20,+20)	-	t-test
Mehdian et al. (2008)	14 favorable and 14 unfavorable economic and political events	Turkey Database: ISE	Returns on indices are used.	ISE-100 and ISE-ALL	(0,+30)	-	t-test
Muradoğlu and Aydoğan (1998)	513 stock dividend/rights offerings decisions of 169 companies	Turkey Database: Capital Market Board of Turkey	Market adjusted returns	ISE-Comp. Index	(-30,+30)	-	t-test and rank test
Muradoğlu and Aydoğan (2003)	513 stock dividend/rights offerings decisions of 169 companies	Turkey Database: Capital Market Board of Turkey	Market adjusted returns	ISE-Composite Index	(-30,+30)	-	t-test, rank test and sign test

Table 2 (cont'd)

Muslumov (2008)	7224 insider trading	Turkey Database: ISE daily bulletins	Market adjusted volatilities	No info	(-2,+2)	Different pre-announcement windows over (-50,-3) and post-announcement windows (+3,+50)	t-test
Mutan and Topcu (2009)	10 events' impact on index	Turkey Database: Central Bank of Turkey	Market adjusted returns	ISE-100	(-30,-11)	(0+10)	t-test
Odabasi (1998)	603 earnings announcements	Turkey Database: ISE and database of the Center for Applied Research in Finance (CARF) of the Bogaziçi University	Simple market model	ISE-100	(-15,+15)	(-60,-16) and (+16,+30)	t-test
Oelger and Schiereck (2011)	112 acquisitions	Turkey Database: Thomson One Banker	Simple market model	ISE-100	(-20,+20)	(-220,-21)	t-test
Onar and Topcu (2011)	50 strategic decisions	Turkey Database: ISE (for price data), Turkish Statistical Institute	Not indicated	No info	(-3,+3)	100 days estimation period	t-test

Table 2 (cont'd)

Otlu and Ölmez (2011)	53 stock certificates	Turkey Database: ISE and Finnet	Market adjusted returns	ISE-TUM (ISE-ALL)	Over 1-21 days	-	t-test
Özer and Yücel (2001)	686 rights and bonus issues	Turkey Database: ISE	Market adjusted returns	ISE-100	(-20,+20)	(-61,-21)	Patell test
Özkanlı (2011)	43 public announcements of one firm from textile industry	Turkey Database: Central Bank of Turkey	Market adjusted returns (simple market model & mean adjusted returns are not presented, but applied)	ISE-100	(-5,+5)	-	-
Penas and Tumer-Alkan (2010)	199 bank-quarter observations	Turkey Database: ISE	Market adjusted returns	ISE-100	(-1,0)	-	t-test
Sakarya (2011)	11 stocks	Turkey Database: Garanti Bank (paragaranti.com	Market adjusted returns	ISE-100	(-10,+10)	-	t-test

Table 2 (cont'd)

		for prices and tkyd.org for ratings)					
Solakoglu and Orhan (2007)	52 acquirer and target information	Turkey Database: Bloomberg data through a local investment firm (for M&A) and www.analiz.com	Simple market model	ISE-100	(-10,+10)	(-90,-11)	t-test
Tahaoğlu and Güner (2011)	9163 insider transactions in shares of 216 companies	Turkey Database: ISE	Fama-French Three Factor Model	ISE-ALL	-	Portfolio formation method is used. (5, 10, 21, 42, and 63 day holding periods are used)	t-test (regression analysis)
Taşcı (2008)	8 banks	Turkey Database: bulletins of ISE for the announcements and Finnet for price data	Simple market model	ISE-100	(-3,+3)	(-315,-4)	CDA

Table 2 (cont'd)

Teker and Ekit (2003)	34 IPOs	Turkey Database: ISE	CAPM	Not defined in the article	(-1,-91)	(0,30)	t-test and Wilcoxon signed rank test
Tükel (2010)	42 IPOs	Turkey Database: ISE	Market adjusted returns	ISE-100	1st trading day and 36 months following the IPO	-	t-test
Yalçıner (2006)	IPOs of 93 firms	Turkey Database: ISE and IBSAnaliz.com.tr	Market adjusted returns	Not defined in the article	1, 2, 3, 4, 5, 6, 7 trading days, 1, 2, 3, 4, 5 months following the IPO	-	t-test
Yazıcı and Muradoglu (2001)	199 recommendations, 89 different stocks	Turkey Database: Stock recommendations by "Investor Ali" (from the issues of Moneymatik Magazine)	Market adjusted returns	ISE-100	(-19,+20)	-	t-test
Yılmaz and Gulay (2006)	602 cash dividend payment events	Turkey Database: ISE	Market adjusted returns	ISE-100	(-10,+10)	-	t-test

Table 2 (cont'd)

Yolsal (2011)	45 stock splits out of 159 stock splits (selected once randomly)	Turkey Database: www.imkb.gov.tr www.kap.gov.tr	Simple market model	ISE-100	(-10,+10)	(-89,-11)	Traditional t-test, Patell test, BMP t-test, Corrado-Zivney Rank test, Corrado's Rank Test
Yörük and Ban (2006)	8 mergers	Turkey Database: ISE	Market adjusted returns	ISE-100	(-116,+116), (-30,+30), (-20,+20), (-10,+10), (-5,+5)	-	t-test
Yucel and Taskin (2007)	All listed companies over 1992-2005 are used to form portfolios.	Turkey Database: www.analiz.com	Market adjusted returns		(-11,0) monthly returns	-	t-test

2.3 Applications of Brown and Warner

Different than other studies up to 1980, Brown and Warner (1980) used monthly abnormal returns in a pseudo-event study instead of actual events in order to examine the security performance in the US over 1944-1971. Their basic aim was to compare different methodologies. They use 250 samples each with 50 securities, which are selected randomly with replacement. Assuming that the event month at time zero, the estimation window is defined as (-89, +10), containing 100 number of returns. Basically three groups of models (mean adjusted, market adjusted and market and risk adjusted models) are compared based on their power (i.e., rejecting the null hypothesis of no abnormal performance, when it is false) and specification error. Their parametric and non-parametric test results show that without clustering mean adjusted returns perform as good as the other alternatives. However, under possible problems the best methodology is the market and risk adjusted simple market model. Brown and Warner (1980) contribute to the existing literature in two ways: First, their study is a pseudo-event study like a Monte Carlo simulation, but using actual returns. Second, their paper presents a clear guideline to compare various models and tests, which was followed by more than a thousand papers.

Brown and Warner (1985) expanded their study by employing daily stock returns in the US over 1972-1979. They use 250 daily returns for each share where (-244, -6) denotes the estimation window and (-5, +5) is the event window. They typically preserve the experimental design, but mention some unique problems of daily data: non-normality, non-synchronous trading, variance shifts and relation between the distribution of returns and test statistic. Similarly, they compare three models and conclude that market and risk adjusted model performs best with daily data for the US by using a parametric test. Other studies (Collins and Dent, 1984; Dyckman et al., 1984; Jain, 1986; Bernard, 1987; Heinkel and Kraus, 1988) also indicate the good performance of parametric test statistics with proper specification and high power of tests by using the New York Stock Exchange data.

First replication of BW's approach is done by Kwok and Brooks (1990) on the foreign exchange markets over 1978-1988. Kwok and Brooks use eight currencies, and abnormal returns are calculated based on the daily interest rates and exchange rates. Event window is defined as (-5, +5), and (-55, -6) window is used for estimation. Following BW, they form 100 samples, each with 50 days of observation. Also, they compare mean adjusted returns, market adjusted returns and market model as well as a basic random walk model representing the International Fisher Effect. According to their results, the choice of market index does not lead to a significant change in results, as in BW. On the other hand, in most of the cases the market and risk adjusted model dominates other models (contrary to BW, who argue that mean adjusted model can also perform well in cases without clustering problem). Therefore, they claim that the results of BW cannot be directly generalizable to the foreign exchange markets.

Another similar study by Corrado and Truong (2008) examines the arithmetic and logarithmic returns for the market model in the Asia-Pacific markets over 1994-2006. By using an estimation period of 200 days (from -204 to -5), they calculate the abnormal returns. They employ both parametric (Patell test and bootstrap) and non-parametric tests (generalized sign and generalized rank tests). For test statistics 50,000 security/event-date combinations from each market are used. Each of the 1000 portfolios is formed by sequential sampling from the 50,000 security/event-date combinations, and also each of 1000 test simulations in each market is based on a portfolio of 50 security/event-date combinations randomly selected without replacement. Similar to BW, they compare the power of tests under different market indices, clustering and with/out introduction of artificial abnormal performance. Based on the test results, they conclude that in general a market model with equal weighted market index fits the Asia-Pacific security markets. Comparing the performance of test statistics, they emphasize the superiority of non-parametric tests (especially the generalized rank test) over parametric ones.

A recent study by Campbell et al. (2009) tries to fill the gap with the application of BW to non-US markets. They use daily security returns from 54 countries, including Turkey, over 1988-2006. Because they conduct a multi-country analysis, they define the market index as "level one" Datastream Global index series (value weighted index). In line with the BW, they use market adjusted returns and market model. Extending the sample size of BW, Campbell et al. (2009) use 1,000 samples, each with 100 security events. (-256, -6) is used as the estimation period, and (-5, +5) is the event window. Two parametric (Patell Z-statistic and crude dependence adjustment test of BW) and three non-parametric tests (generalized sign test, generalized rank test and jackknife test) are used to test the null hypothesis of no abnormal returns. Their results indicate that non-parametric tests perform better (the sign test is even more powerful than the rank test for longer event windows), and both market adjusted returns and market model methods work well. Nevertheless, their study is open to some problems. First, use of "level one" index can be misleading since this index includes only the most important companies (based on the market value) instead of all firms. If the market model would be considered from a single country's point of view, then this choice of market index can be quite misleading. Besides, choice of an equal weighted index could perform better as in Corrado and Truong (2008). Second, this study conducts an analysis of 1,000 samples of non-US securities, but country-specific results are not presented. Rather they use a pool of countries and consider country clustering as an additional sensitivity analysis. Even though the most concentrated markets and markets with the most non-normally distributed returns are separately investigated, there is not a country-specific analysis.

Considering these studies, Campbell et al. (2009) is the first comprehensive non-US application of BW methodology. The literature on this topic is still in its infancy. Therefore, this thesis contributes to the existing literature in two ways. First, existing papers consider only a limited number of markets. Especially the focus on developed markets indicates that previous results had been considered as generalizable for developing markets. Nevertheless, we do not know which model would perform better for each market since each market does not have the same characteristics. Besides, there can be significant differences between developed and developing markets that have been discovered yet. Indeed, Campbell et al. (2009) and Corrado and Truong (2008) show how examples from non-US markets significantly differ from the US market. In general, the returns in non-US markets are more volatile and deviation from normality is more severe.

Second, this thesis would be one of the event studies conducted for Turkey. There have been previous event studies testing the impact of different "events" on security prices summarized in Section 2.2. Nevertheless, after Gümüş (2008) this thesis is the first comprehensive attempt to understand the features of returns and the underlying model in the Turkish stock market. In the study of Campbell et al. (2009) 371 stocks (with mean number of returns per stock: 2,561) are used from Turkey over 1988-2006. This amount constitutes only the 1.2 per cent of their whole sample[10]. The mean of returns for Turkey is 0.004 with highly non-normal distribution features. The percentage of zero returns is nearly 20 (quite high number but not higher than the 27.7 per cent recorded at the US market). Nevertheless, Campbell et al. (2009) do not provide country-specific model nor test analysis meaning that Turkey is considered only within a huge sample. Therefore, this study aims to follow BW, similar to Campbell et al. (2009), but to focus only on the Turkish stock market. By giving an insight about the underlying model for Turkish stock market this thesis provides a guideline for future studies that would adopt event study methodology in order to investigate the impacts of various political or economic events on stock prices in Turkey. Indeed, as seen in the previous studies for Turkey summarized in Section 2.2, there is no reasoning in the selection of the performance model creating a gap in understanding the Turkish stock

[10] Even though Campbell et al. (2009) provide only the number of stocks per country, the percentage of overall sample based on the number of returns per country used in the analysis is provided. Turkey constitutes only 1.2% of the sample based on the number of returns.

market. Without analyzing the best-fitting model, it would be misleading to conduct and interpret tests.

CHAPTER 3

DATA

This thesis uses Datastream to obtain security prices over January 4, 1988 – February 24, 2012 for the Borsa Istanbul. Datastream price data type P, which is adjusted for stock splits and other capital events, is used for analysis. Stock returns are calculated by using the stock price of the last trading date. Arithmetic returns and logarithmic returns are calculated as follows:

Arithmetic returns: $$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \quad (1)$$

Logarithmic returns: $$LR_t = \ln(\frac{P_t}{P_{t-1}}) \quad (2)$$

The market index is gathered from the Borsa Istanbul. As observed in the studies of BW, Corrado and Truong (2008) in Asia-Pacific markets or Campbell and Wasley (1993) for the Nasdaq, the results may depend on the choice of market index, even though some studies find robust results (Thompson, 1988). However, in the Borsa Istanbul only value weighted indices are calculated. In order to create equal weighted indices the companies within the scope of the index, which are updated at each quarter, should be listed. Nevertheless, the Borsa Istanbul does not provide a separate historical list of stocks included in the indices. Correspondingly, only value weighted index, BIST-100, which is the most commonly used and most representative considered index, is used in the analysis[11].

3.1 Size of the Borsa Istanbul

The Istanbul Stock Exchange (ISE) was established on December 26, 1985 and started to operate on January 3, 1986. The ISE was a public corporation with the aim of development of the Turkish capital markets and Turkish economy. The ISE was designated as an "Eligible Foreign Custodian" by US Securities and Exchange Commission (SEC) in 1995. The ISE has shareholding interests not only in Turkish parties, but also in the Kyrgyz Stock Exchange, Baku Stock Exchange and Sarajevo Stock Exchange.

Following the new Capital Market Law numbered 6362 and came into force on December 30, 2012; Borsa Istanbul is established with the aim of consolidating all exchanges under one roof. Borsa Istanbul is officially registered and started its operations on April 3, 2013.

Even though the ISE was established at the end of 1985, the market capitalization is still low compared to developed financial markets[12]. On the other hand, compared to the early years of trading there is a rapid and significant growth in the market (Table 3). In 2012, the nominal traded value

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[11] Even though the composition of the index changes quarterly depending on the market capitalization of stocks, in order to represent the market BIST-100 is selected following the previous studies on Turkey indicated in Section 2.2 where 54 out of 71 studies on Turkey choose ISE-100 Index (BIST-100).

[12] According to the statistics published by theWorld Federation of Exchanges (available at: http://www.world-exchanges.org/statistics), the market capitalizations of BM&BOVESPA ($1,227bn), NASDAQ OMX ($4,582bn), TMX Group ($2,058bn), Korea Exchange ($1,179bn), Taiwan Stock Exchange ($735bn) and SIX Swiss Exchange($1,233bn) are all above Borsa Istanbul as of end of 2012.

in the market was $347 billion over 78 million contracts. Besides, there were 395 listed companies traded on the ISE markets as end of the year.

Table 3. Some facts at the Borsa Istanbul Stock Market

Year	Number of Companies Listed	Traded Value (million USD)	Number of Contracts* (million)	Market Capitalization (million USD)
1986	80	13	-	938
1990	110	5,851	0.8	18,737
2000	315	181,934	32.4	69,507
2010	350	425,747	81.4	307,551
2012	395	347,853	78.8	309,644

Note: Number of companies listed includes listed Investment Trusts, REITs, Venture Capital Investment Trusts and ETFs. Market capitalization is the value as of end of year.
(*) Assuming that the price of one stock is 10 TL, if there is 1 lot buy and 1 lot sell in a contract, and 150,000 lots buy and 150,000 lots sell in another contract, then the number of contracts would be 2, and traded value would be 1,500,010 TL.
Source: http://www.imkb.gov.tr/Data/Consolidated.aspx

3.2 Properties of Datastream Database

As emphasized this thesis uses Datastream as the main database to obtain adjusted security prices over January 4, 1988 - February 24, 2012 for Borsa Istanbul. Prices are exported in Excel format. Over 1988-2012 (dead or survived) 471 securities [13] are included in the analysis, but after the application of criteria (explained in Part 4) on these firms a clean sample is obtained. For the holidays, the last trading day's price is used in order to calculate the returns[14].

Some basic observations about the database and corresponding modifications on the acquired file are listed below:

- The database uses "NA" to show the dates where the prices are not available. Therefore, as a first step all "NA" symbols are transformed into empty cells.
- One of the most important drawbacks of using Datastream is to identify companies. Even though the database indicates failed firms within the name of the company as follows: "ABANA ELEKTROMEKANIK DEAD - 01/05/08" implying that the trading of the shares of ABANA ELEKTROMEKANIK stopped on May 1, 2008, the price series still continues after 01.05.2008 with the constant price of the last day. In order to prevent this misleading case, all names are scanned for the word "dead" and all prices after the indicated date are

[13] Indeed, 506 securities are imported from the database, but after the elimination of 35 duplicate entries 471 securities are left.

[14] In case the index value is missing on a specific day whereas the stock price presents in the database, this observation is not used in the analysis since it is not possible to have a price value on a non-trading day.

replaced with blank cells. Same replacement[15] is also made for the names including the word "merger"[16]. On the other hand, for the shares in "suspended" position no adjustment is made. In addition to these adjustments another Excel book imported from the Datastream including the explanations and details of the securities. This file is used as a checklist to guarantee to eliminate non-traded days. For all other name changes that are not arising due to merger and acquisition are treated as separate stocks.

- Out of 471 names of the companies, 91 names include the word "dead".
- Except the "dead" firms, only 1 firm has the name with the word "merger": "Koc Investment".
- Out of 471 names of the companies, only 1 name (Arat Textile) includes the word "susp" within the name ("Arat Tekstil Susp – 04/06/07).
- Comparing the details and the word search over database, following differences are highlighted:
  - Some firms (namely, Akçimento, Başkent Menkul Kıy., Bayraklı Boya, Çanakkale Çimento, EGS Fin. Kir., and Gorbon Işıl Seramik) are identified as "dead" from the checklist. Because the dates for these firms are not

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[15] The replacement is made for the merged firms since for a merged firm the prices of both the merged one and acquirer exist. For the merged one, the price series becomes a constant number (i.e., last trading day's price) and is needed to be corrected with blank cells.

[16] Only for "Transtürk Fren" shares the merger date is taken as 17.04.1998 since the date was not explicitly stated. All other dates for "dead" and "merger" are taken from the Datastream as it is.

indicated within the database, corresponding Borsa Istanbul bulletins are used to identify these dates.

- Indeed, the sample of 471 securities also includes ETFs (Exchange Traded Funds). ETF is a security that tracks an index, a commodity or a basket of assets like an index fund, but trades like a stock on an exchange[17]. First ETF traded on the Borsa Istanbul is issued by Finansbank (Dow Jones İstanbul 20 with the code DJIST) in 2007. Therefore, considering the length of the traded days, ETFs are also included in the analysis. Out of 471 securities, 460 are equities and 11 securities are ETFs.

Besides, there is no sector discrimination made in the analysis (i.e., all firms from different sectors are included without any limitation). Considering the sectors of firms, the sample is dominated by the financial services sector with 46 equities, followed by the construction and materials sector (Table 4). Closed-end mutual funds are also included in the analysis under "equity investment instruments".

Additionally, in order to include as many stocks as possible in the analysis, no discrimination based on the markets is made. In case there would be infrequent price changes in some markets such as

[17] ETFs experience price changes throughout the day as they are bought and sold. ETFs always bundle together the securities that are in an index; they never track actively managed mutual fund portfolios. Because ETFs are traded on stock exchanges, they can be bought and sold at any time during the day (unlike most mutual funds). Their price will fluctuate from moment to moment, just like any other stock's price, and an investor will need a broker in order to purchase them, which means that he/she will have to pay a commission. On the plus side, ETFs are more tax-efficient than normal mutual funds, and since they track indexes they have very low operating and transaction costs associated with them. There are no sales loads or investment minimums required to purchase an ETF.

Watch List Companies, the criteria explained in Chapter 4 are applied in order to handle infrequent trading.

Table 4. Sectoral Breakdown of Securities by Instrument Type

Sector Name	Equity	Exchange-Traded Fund (ETF)	Total
Automobiles and Parts	12		12
Banks	32		32
Beverages	11		11
Chemicals	13		13
Construction and Materials	41		41
Electricity	8		8
Electronic and Electrical Equipment	7		7
Equity Investment Instruments	14		14
Financial Services (Sector)	46		47
Fixed Line Telecommunications	1		1
Food and Drug Retailers	8		8
Food Producers	31		31
Forestry and Paper	4		4
Gas, Water and Multi-utilities	1		1
General Industrials	15		15
General Retailers	10		10
Health Care Equipment and Services	2		2
Household Goods and Home Construction	21		21
Industrial Engineering	22		22
Industrial Metals and Mining	14		14
Industrial Transportation	7		7

Table 4 (cont'd)

Leisure Goods	4		4
Life Insurance	1		1
Media	10		10
Mining	5		5
Mobile Telecommunications	1		1
Non-Equity Investment Instruments		11	11
Nonlife Insurance	8		8
Oil and Gas Producers	4		4
Personal Goods	37		37
Pharmaceuticals and Biotechnology	2		2
Real Estate Investment and Services	6		6
Real Estate Investment Trusts	19		19
Software and Computer Services	3		3
Support Services	7		7
Technology Hardware and Equipment	10		10
Tobacco	1		1
Travel and Leisure	17		17
Unclassified	5		5
Grand Total	**460**	**11**	**472**

- Borsa Istanbul provides a list of companies with stocks de-listed from the Borsa Istanbul markets permanently (as from year 2000) and companies with stocks de-listed because of acquisitions (as from year 2000). Even though the list of companies with stocks de-listed from the markets is not completely shared with the public, the existing dates are compared with the dates indicated by the Datastream. Table 5 shows the differences between two information sources. "-" symbol denotes that the dates stated by two information sources are the same.

By using the unadjusted price data of the Borsa Istanbul (in order to check for the existence of any trading), the modifications are carried out and stated at the rightmost column. The earliest de-listing date among the dates stated in the Datastream and Borsa Istanbul is used to calculate the price series. Only for the dates indicated by the Borsa Istanbul, but not mentioned by the Datastream, the data from the Borsa Istanbul are used. Lastly, there are some equities mentioned by the Borsa Istanbul, but not included in this analysis (Codes: ALFA, KOYTS, ENKA and SYBNK)[18].

Table 5. Comparison of the list of Borsa Istanbul and the Datastream

CODE	STOCK NAME	DE-LISTING DATE	DATE INDICATED IN THE DATASTREAM	DATASOURCE USED TO CORRECT PRICES
COMPANIES WITH STOCKS DE-LISTED FROM THE BORSA ISTANBUL MARKETS PERMANENTLY (*) (AS FROM YEAR 2000)				
BYSAN	BOYASAN TEKSTİL	10.10.2011	20.02.2009	Datastream
TUMTK	TÜMTEKS	10.10.2011	Not indicated in the Datastream	Borsa Istanbul
EGFIN	EGS FİN.KİR.	12.11.2010	-	-
SPTUR	SP-IFCI AKBANK BYF	22.02.2010	15.05.2010	Borsa Istanbul
MEGES	MEGES BOYA	24.12.2008	23.12.2008	Datastream
ARAT	ARAT TEKSTİL	17.11.2008	Not indicated in the Datastream Only suspension date was in the Datastream.	Borsa Istanbul

[18] We could not find for an explanation for these stocks that are not found in the Datastream.

Table 5 (cont'd)

ALFA	ALFA MENKUL DEĞ.	17.11.2008	Not found in the Datastream	Not found in the Datastream
EGIYM	EGESER GİYİM	17.11.2008	12.11.2002	Datastream
EGHOL	EGS HOLDİNG	17.11.2008	12.11.2002	Datastream
MEDYA	MEDYA HOLDİNG	17.11.2008	23.10.2002	Datastream
SABAH	SABAH YAYINCILIK	17.11.2008	23.10.2002	Datastream
SAPAZ	SABAH PAZARLAMA	17.11.2008	27.10.2000	Datastream
LIOYS	LİO YAĞ	19.09.2008	11.10.2006	Datastream
ABANA	ABANA ELEKTROMEKANİK	01.05.2008	-	-
RAKSE	RAKS ELEKTRONİK	15.06.2007	02.06.2005	Datastream
RKSEV	RAKS EV ALETLERİ	15.06.2007	02.06.2005	Datastream
UNTAR	ÜNAL TARIM	07.02.2007	08.02.2007	Datastream
KOTKS	KONİTEKS	07.02.2007	08.02.2007	Datastream
GORBN	GORBON IŞIL	22.12.2004	-	-
IKTFN	İKTİSAT FİNANSAL KİRALAMA	13.05.2004	23.10.2002	Datastream
FACF	FACTO FİNANS	13.05.2004	23.10.2002	Datastream
METAS	METAŞ	08.10.2003	09.10.2003	Datastream
CUKEL	ÇUKUROVA ELEKTRİK	18.06.2003	-	-
KEPEZ	KEPEZ ELEKTRİK	18.06.2003	11.06.2003	Datastream
SEZGD	SEZGİNLER GIDA	18.11.2002	20.11.2002	Datastream
AKTAS	AKTAŞ ELEKTRİK	16.08.2002	-	-
EGDIS	EGS DIŞ TİCARET	16.08.2002	12.11.2002	Borsa Istanbul
GUMUS	GÜMÜŞSUYU HALI	16.08.2002	12.11.2002	Borsa Istanbul
KOYTS	KÖYTAŞ TEKSTİL	16.08.2002	Not found in the Datastream	Not found in the Datastream
SOKSA	SÖKSA	16.08.2002	24.06.1999	Datastream
MDRNU	MUDURNU TAVUKÇULUK	07.05.2002	07.05.2003	Borsa Istanbul

Table 5 (cont'd)

TPBNK	TOPRAKBANK	31.01.2002	02.01.2002	Datastream
EMEK	EMEK SİGORTA	30.01.2002	12.11.2002	Borsa Istanbul
APEKS	APEKS DIŞ TİCARET	15.01.2002	11.08.2000	Datastream
INMDY	INTERMEDYA	15.01.2002	11.11.1998	Datastream
IHFIN	İHLAS FİNANS	07.11.2001	02.04.2002	Borsa Istanbul
DEMIR	DEMİRBANK	20.09.2001	27.09.2001	Borsa Istanbul
SVGSH	SEVGİ SAĞLIK HİZM.	09.07.2001	10.03.2000	Datastream
ESBNK	ESBANK	03.04.2001	22.12.1999	Datastream
YABNK	YAŞARBANK	03.04.2001	22.12.1999	Datastream
EMSAN	EMSAN BEŞYILDIZ	18.10.2000	18.02.2000	Datastream
EMPAS	EMSAN PAS.ÇELİK	18.10.2000	18.02.2000	Datastream
COMPANIES WITH STOCKS DE-LISTED FROM THE EXCHANGE PERMANENTLY BECAUSE OF ACQUISITIONS (AS FROM YEAR 2000)				
FORTS	FORTIS BANK	16.02.2011	18.02.2011	Borsa Istanbul
AKIPD	AKSU İPLİK	25.12.2009	-	-
GRUND	GRUNDİG ELEKTRONİK	10.07.2009	-	-
YTFYO	YATIRIM FİN. YAT.ORT.	10.07.2009	-	-
MIGRS	MİGROS	02.06.2009	Not indicated in the Datastream	Borsa Istanbul
CYTAS	CEYTAŞ MADENCİLİK	22.05.2009	-	-
KAVPA	KAV DAN.PAZ.TİC.	28.07.2008	-	-
OYSAC	OYSA ÇİMENTO	09.11.2007	13.11.2007	Borsa Istanbul
CMLOJ	CAMİŞ LOJİSTİK	03.09.2007	-	-
EFES	EFES HOLDİNG	27.12.2006	-	-
TOPFN	TOPRAK FİN. KİR.	09.11.2006	07.11.2006	Datastream
GIMA	GİMA	22.08.2006	-	-
TNSAS	TANSAŞ	03.08.2006	-	-
AGIDA	ANADOLU GIDA	23.02.2004	-	-
MARET	MARET	23.02.2004	11.08.2003	Datastream
PASTA	PASTAVİLLA	11.08.2003	-	-

Table 5 (cont'd)

ENKA	ENKA HOLDİNG	22.07.2002	Not found in the Datastream	Not found in the Datastream
BYRBY	BAYRAKLI BOYA	10.06.2002	-	-
SYBNK	SINAİ YATIRIM BANKASI	26.04.2002	Not found in the Datastream	Not found in the Datastream
TOFAS	TOFAŞ OTO TİCARET	11.06.2001	-	-
PNET	PINAR ENTEGRE ET	11.08.2000	10.08.2000	Datastream
PNUN	PINAR UN	11.08.2000	10.08.2000	Datastream
ANBRA	ANADOLU BİRACILIK	24.07.2000	-	-
EGBRA	EGE BİRACILIK	24.07.2000	-	-
ERCYS	ERCİYAS BİRACILIK	24.07.2000	21.07.2000	Datastream
GUNEY	GÜNEY BİRACILIK	24.07.2000	21.07.2000	Datastream

Notes: "-" symbol denotes that the dates stated by two information sources are the same. For "not indicated" dates, the dates of the Borsa Istanbul are used. "Not found" equities are not added to the analysis.

- Another problem of using the Datastream is that there are "zero prices". Since price cannot be zero, all zero cells are replaced with blank cells[19].

To sum up, Datastream database has some major drawbacks: identification of de-listed firms, NA and zero entries and transformation of these entries, and inconsistencies with the Borsa Istanbul. On the other hand, Borsa Istanbul itself does not provide adjusted price data. Therefore, Datastream helps to present an adjusted series for several securities over a

[19] 62,467 replacements are made.

long period. As a result of the transformations done above, available number of firms per day could be visualized in Figure 1. Datastream provides 1,475,196 observations for 471 securities over January 4, 1988 - February 24, 2012. In general, 506 securities (1,806,588 prices) are imported from the database, but after the elimination of 35 duplicate entries 471 securities (1,475,667 prices) are left. Comparing the listed firms in the Borsa Istanbul as of end of year and those in the Datastream (Figure 1), except the early years of the Exchange, Datastream covers most of the firms. In some cases, the list of firms in Datastream is higher due to the mismatches in the dates of trading between databases indicated above[20].

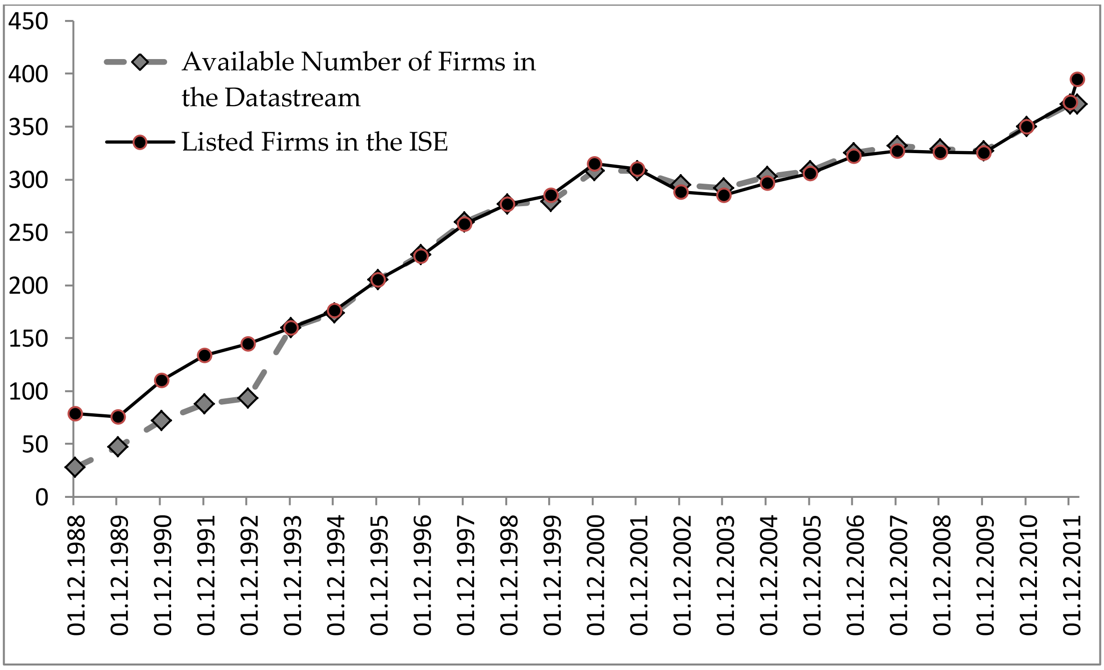

Figure 1. Available Number of Firms per day

[20] Around 2 per cent of mismatch is observed in these kinds of years.

CHAPTER 4

EXPERIMENTAL DESIGN

Simulation procedure of BW is followed by a number of studies (Corrado, 1989; Cowan, 1992; Campbell and Wasley, 1993, 1996; Cowan and Sergeant, 1996; Savickas, 2003; Corrado and Truong, 2008). The basic logic of the procedure is to select a random stock and an event day and repeat this for each stock. Then, in order to compare the performance of tests/models an artificial abnormal return is added for each event date at time zero. Lastly, cumulative abnormal returns are examined over the event window.

4.1 Sample Selection

Similar to Brown and Warner (1985), 250 samples are constructed, where each sample contains 50 securities. The securities are selected at random and with replacement from the "dataset"[21]. Considering the limited number of firms listed at Borsa Istanbul, the choice of firms with replacement is applied[22]. Therefore, same firm can be included more than once in event study samples. On the other hand, for the clustering case considered in Part 6

[21] In Excel, a seed for the random number generator is given to create the sample design.

[22] Choice of firms with replacement also helps to generate large number of samples.

the firms are selected without replacement in order to prevent any bias within the samples.

For each security a hypothetical event date among the trading days with equal probability between January 4, 1988 and February 24, 2012 is chosen. The estimation window is determined as the period between 244 days before the event date and 6 days before the event date, where the event date (time zero) refers to the date with abnormal returns. Therefore, (-244,-6) denotes the estimation window whereas (-5,+5) is the event window. Correspondingly, for each security 250 daily returns are used.

To be included in our "dataset", stocks have to fulfill the following criteria:

Criteria 1: The stocks, which have number of returns less than 250 between January 4, 1988 and February 24, 2012, are eliminated[23].

Criteria 2: The stocks, which have less than 50 returns over its corresponding estimation window, are excluded from the analysis[24].

Criteria 3: All one-day outlier returns greater than 1000% or less than -100% are excluded[25,26].

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[23] This criteria resulted in the elimination of 30 stocks (ignoring the outliers).

[24] This criteria resulted in the elimination of 18 stocks (ignoring the outliers).

[25] This criteria is defined following the same definition in Corrado and Truong (2008) in order to eliminate erroneous entries since there is already price limit regulation in Borsa Istanbul (see Section 6.7.2 for detailed information on price limits).

[26] This criteria resulted in the elimination of 24 stocks (only greater than 1000%).

Criteria 4: The stocks, which have more than 30 consecutive missing returns over the combined estimation and event windows, are eliminated[27].

Criteria 5: The stocks, which have more than 90 consecutive zero returns over the combined estimation and event windows, are eliminated[28]

Criteria 6: The stocks, which have missing return over the event window, are excluded from the analysis (i.e., full event window)[29].

Even after the application of these criteria, the survivorship bias would still exist since the sample design would have a tendency to select firms with full data.

4.2 Abnormal Return Measures

As discussed in Part 2, this thesis employs mean adjusted returns, market adjusted returns and market model returns.

4.2.1 Mean Adjusted Returns

Mean adjusted returns are calculated by assuming that the mean return over the estimation period, (-244, -6), is the expected return. Therefore, any deviation from the expected return would be abnormal returns:

Abnormal returns: $$AR_{i,t} = R_{i,t} - \bar{R}_i \qquad (3)$$

[27] This criteria resulted in the elimination of 75 stocks (ignoring the outliers).

[28] Not a single stock is eliminated with this criteria.

[29] This criteria resulted in the elimination of 6 stocks (ignoring the outliers).

Simple average over the estimation period: $\bar{R}_i = \frac{1}{239} \sum_{t=-244}^{-6} R_{i,t}$ (4)

Equation (4) and subsequent equations are modified for missing observations by excluding days as calculating the averages where $R_{i,t}$ are unavailable, and modifying calculations to reflect the smaller number of available observations.

4.2.2 Market Adjusted Returns

Market adjusted abnormal returns are simply the difference between actual returns and the market return:

Abnormal returns: $AR_{i,t} = R_{i,t} - R_{m,t}$ (5)

where $R_{m,t}$ is the value weighted index, BIST-100 Index, for day t. Since an equally weighted index for Borsa Istanbul is not currently available, only the value weighted index is used.

4.3.2 Simple Market Model

Abnormal returns are: $AR_{i,t} = R_{i,t} - \hat{\alpha}_i - \hat{\beta}_i R_{m,t}$ (6)

where $\hat{\alpha}_i$ and $\hat{\beta}_i$ are OLS estimates over the estimation period for security i.

4.3 Introduction of Abnormal Returns and Power of Test

Similar to BW, abnormal returns are artificially introduced for each security on a randomly selected event date[30]. In case of no abnormal returns (i.e., 0 per cent) the test statistics under the null hypothesis are calculated. Then, 5 per cent abnormal returns are added to each event-date return[31].

Under no abnormal returns, the null hypothesis of "no abnormal returns" should not be rejected. Correspondingly, the Type I error is the probability of rejecting the null hypothesis when it is true. If the null hypothesis is failed to be rejected given 5 per cent of abnormal returns, then Type II error arises (i.e., fail to reject the null hypothesis when it is false). Then, the power of test is one minus Type II error. Under each methodology for each sample Type I and II errors are examined. Type I error gives an idea about the specification/misspecification of the test under the given model whereas Type II error is used to calculate the power of a test.

4.4 Event Study Test Statistics

According to the classification of non-US event studies by Campbell et al. (2009), 16 of 18 studies employ at least one parametric test. Besides, 7 of these 16 studies apply non-parametric tests together with parametric tests. They state the following parametric tests: "crude dependence adjustment (CDA)" of BW, Patell Test, standardized cross-sectional and t-tests. From the

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[30] However, in this design a constant abnormal return is added to stock's return exactly at time zero. Therefore, for all cases it is known that the artificial abnormal return exists at time zero. On the other hand, in BW's approach a constant abnormal return is added on a randomly selected event-date return within the event window.

[31] Also 1% and 2% per cent artificial returns are added to each event-date return. Since the results support the results with 5%, only the ones for 5% are presented here.

non-parametric tests, the Wilcoxon signed rank test, generalized sign and generalized rank tests are listed. Campbell et al. (2009) claim that non-parametric test, especially the rank and sign tests, are better specified and more powerful than parametric tests, especially in multi-day windows, because of serious non-normality problems[32]. It is also stated that "in random samples, the rank test does not reject a true null too often and has good power to detect an abnormal return on a known event date" where these results generally hold in the presence of variance increases on event date. Since non-parametric tests are also found robust, these studies suggest that both parametric and non-parametric tests should be applied at the same time.

Correspondingly, the basic benefit of using non-parametric tests would be to detect the abnormal returns when there is actually abnormal returns (the power of test), and decrease the probability of rejecting the null hypothesis of no abnormal returns when there is no actual abnormal returns (the specification of test). To illustrate; considering 250 random samples if the specification error would be 20 per cent, this result would imply that that test would reject the null hypothesis of no abnormal returns on average in 80 per cent of the cases even though there is no abnormal returns. Besides, low power of the test would refer that the test would be weak to detect the abnormal returns even though there would be abnormal returns. Low specification and power of tests would lead to misleading interpretations

[32] It is also important to note that "non-normal distributions at the security level do not mean that parametric tests are necessarily misspecified" but for some tests the underlying assumptions and some parameters at security level may cause specification problems.

(such as a researcher claiming the efficiency or inefficiency of a market based on these results).

Therefore, considering the most used tests this thesis adopts two parametric tests (portfolio time-series standard deviation test and Patell Test[33]) and two non-parametric tests (generalized sign and generalized rank tests). As MacKinlay (1997) supports, non-parametric tests would be used in conjunction with the parametric tests. Besides, inclusion of the nonparametric tests would provide a check for the robustness. In case some tests would dominate the others, the outperformance of parametric or non-parametric tests as well as robustness of the test can be stated. In other cases, a conclusion cannot be made on the performance of tests.

4.4.1 The Portfolio Time-series Standard Deviation Test (Crude Dependence Adjustment Test - CDA)

BW defines this test as CDA whereas Campbell et al. (2009) describes it as the portfolio time-series standard deviation test. The test statistic is computed by dividing the mean abnormal returns of event date with the standard deviation of abnormal returns. BW (1985) emphasize that this test is able to correct for cross-sectional dependence since the portfolio excess returns are used. As long as the abnormal returns are normally and i.i.d. (independently and identically distributed), the test statistic will be

[33] Even though there is a Patell test corrected for Shift in Cross-sectional Variance over multi-day windows, here only these four tests are considered. It is criticized that the over event window the standard deviations would be higher altering the test statistics. In case of a shift in the variance at time zero it is advised to use corrected tests. Nevertheless, this study uses simulations over the entire dataset with random event dates. Based on the law of large numbers, it is expected to capture full randomization. Therefore, the analysis is kept as simple as possible.

distributed with Student-T (unit normal for large sample sizes). The test statistic for event date (t=0) is:

$$t_{CDA} = \overline{AR}_t / s(\overline{AR}_t) \text{, where} \tag{7}$$

$$\overline{AR}_t = \frac{1}{N_t} \sum_{i=1}^{N_t} AR_{i,t} \tag{8}$$

(N_t: number of securities whose abnormal returns are available for day t)

$$s(\overline{AR}_t) = \sqrt{\frac{\sum_{t=-244}^{-6} (\overline{AR}_t - \overline{\overline{AR}})^2}{238}} \tag{9}$$

$$\overline{\overline{AR}} = \frac{1}{239} \sum_{t=-244}^{-6} \overline{AR}_t \tag{10}$$

Over the event window (-5,+5) the test statistic is:

$$t_{CDA} = \sum_{t=-5}^{+5} \overline{AR}_t \Big/ \left[\sum_{t=-5}^{+5} \hat{s}^2(\overline{AR}_t)) \right]^{1/2} \tag{11}$$

Since the equation (9) refers to a constant number, the denominator of equation (11) becomes: $\sqrt{11} * \hat{s}(\overline{AR}_t)$ for the event window (-5,+5). Basically, equation (11) refers CAR/s(CAR) as test statistic.

4.4.2 Patell Z-Statistic

This parametric test, which is proposed by Patell (1976), Dodd and Warner (1983) and Mikkelson and Partch (1986), assumes that the returns are independent across security-events. Therefore, the results of the Patell test are sensitive to this underlying assumption. The test statistic is calculated by using the standardized abnormal returns as follows:

$$Z_t = \frac{1}{\sqrt{N_t}} \sum_{i=1}^{N} \left(\sqrt{\frac{M_i - 4}{M_i - 2}} \right) \left(\frac{AR_{i,t}}{s_{i,t}} \right) \tag{12}$$

(M_i: the number of returns over the estimation period. In case of no missing observations, M_i would be equal to 239)

where

$$s_{i,t} = s_{i(est)} \left[1 + \frac{1}{239} + \frac{(R_{m,t} - \bar{R}_m)^2}{\sum_{t=-244}^{-6} (R_{m,t} - \bar{R}_m)^2} \right]^{1/2} \tag{13}$$

($\bar{R}_m$: the mean market-index over estimation period calculated as: $\bar{R}_m = \frac{1}{239} \sum_{t=-244}^{-6} R_{m,t}$)

$$s_{i(est)} = \sqrt{\frac{1}{238} \sum_{t=-244}^{-6} (R_{i,t} - \bar{R}_i)^2} \tag{14}$$

$$\bar{R}_i = \frac{1}{239} \sum_{t=-244}^{-6} AR_{i,t} \tag{15}$$

For 11-event day windows, the Patell test statistic becomes:

$$Z = \frac{1}{\sqrt{11N}} \sum_{i=1}^{N} \left(\sqrt{\frac{M_i - 4}{M_i - 2}} \right) \left(\sum_{t=-5}^{+5} \frac{AR_{i,t}}{s_{i,t}} \right) \tag{16}$$

Under the null hypothesis of no abnormal returns Patell test statistic is distributed with Student-t with N degrees of freedom.

Patell test is a standardized abnormal return test or a test assuming cross-sectional independence. Unlike the Patell test, the CDA test uses a single variance estimate for the entire portfolio. Therefore, the CDA test does not take account of unequal return variances across securities, but avoids the potential problem of cross-sectional correlation of security returns.

4.4.3 Generalized Sign Test

Considering the studies finding non-parametric tests superior than the parametric tests (Corrado and Truong, 2008; Campbell et al., 2009), generalized sign and generalized rank tests are employed.

The generalized sign test, proposed by McConnell and Muscarella (1985) and Lummer and McConnell (1989), does not make an assumption on the distribution of returns. The sign test compares the proportion of days with positive abnormal returns over the estimation period with those over event window. The null hypothesis for the generalized sign test is that the fraction of positive returns is the same as in the estimation period. Therefore, the parameter of the test (i.e., the fraction of positive abnormal returns over the estimation window) is:

$$\hat{p} = \frac{1}{N}\sum_{i=1}^{N}\frac{1}{M_i}\sum_{t=-244}^{-6} S_{i,t} \tag{17}$$

where

$$S_{i,t} = \begin{cases} 1 \text{ if } AR_{i,t} > 0 \\ 0 \text{ otherwise} \end{cases} \tag{18}$$

Then, the generalized sign test statistic is:

$$Z_G = \frac{w - N\hat{p}}{\left[N\hat{p}(1-\hat{p})\right]^{1/2}} \tag{19}$$

where w is the number of securities in the event window for which the cumulative abnormal return (CAR_i) is positive. The cumulative abnormal return for stock i over an event window (-5, +5) is defined as follows:

$$CAR_i(-5,+5) = \sum_{t=-5}^{+5} AR_{i,t} \tag{20}$$

4.4.4 Generalized Rank Test

Similar to the generalized sign test, the generalized rank test of Corrado (1989) does not depend on normality assumption. Unlike the generalized sign test, this test focuses on the rank of each security's abnormal return over both estimation and event period instead of the frequency distribution of abnormal returns. Following the extension for multi-day window by Cowan (1992), the test statistic for the event window (-5, +5) is as follows:

$$t_{rank} = \frac{\left[\sum_{t=-5}^{+5}\left(\frac{1}{N_t}\sum_{i=1}^{N} k_{i,t}\right)\right] - \bar{k}}{s_k / \sqrt{11}} \tag{21}$$

where $\bar{k}$ is the mean or expected rank (i.e., one half plus half the number of observed returns. In this case, this value equals to (250/2) 125. Then, the standard deviation is defined as follows:

$$s_k = \left\{ \frac{1}{250} \sum_{t=-244}^{+5} \left[\left(\frac{1}{N_t} \sum_{i=1}^{N_t} k_{it} \right) - \bar{k} \right]^2 \right\}^{1/2} \tag{22}$$

($k_{i,t}$: rank of security i's event window abnormal return within (-244,+5) window)[34].

In this calculation $\bar{k}$ definition of Campbell et al. (2008) is used because Corrado (1989) does not allow for missing observations meaning that the expected rank is constant across securities. On the other hand, Campbell et al. (2008) define the adjusted expected rank measure in (22) by ranking non-missing returns where the lowest rank represents zero.

Cowan (1992) states that even though the rank test is more powerful under ideal conditions, in case of an increase in the length of the event window, an increase in the return variance and thin trading the generalized sign test may be preferred over the rank test. Also, Serra (2002) mentions the fact that Corrado's rank test performs better than parametric tests from the point of specification and power, whereas this situation is reversed under return variance increases –specifically, misspecification problem arises. Cowan and Sergeant (1996) support the specification error of rank test under variance increases.

[34] In this formula the rank of each security is computed as the statistical rank of a given value within a supplied array of values. If there are duplicate values in the list, the average rank is returned.

CHAPTER 5

EMPIRICAL FINDINGS

The robustness measures of the results are considered by applying an artificial abnormal return of 5 per cent and using both arithmetic and logarithmic returns for each test. The estimation period is defined as (-244,-6) and the event window is described as (-5,+5).

For the sample period of 01.04.1988-02.24.2012, a total number of 1,475,196 returns of 471 securities are gathered. Nevertheless, after applying all criteria, 1,381,797 log returns of 388 firms are used as the clean sample[35] (Table 6). There is a slight difference in the number of returns (25 returns) in the clean samples (1,381,797 log returns versus 1,381,822 arithmetic returns) coming from the application of some criteria on the returns in order to get the clean sample[36]. On the other hand, all included securities are same for two clean samples.

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[35] Zero returns are also confirmed by using the available Borsa Istanbul data. The most frequent zero returns are observed for IS BANKASI A and BURSA CIMENTO. It is also noted that most of the zero returns are observed through the early years of the stock exchange.

[36] This difference arises from the outliers: in case of different calculation methods (arithmetic or log returns) one day return may become an outlier and be eliminated in the analysis. These 25 returns are arising due to this calculation difference and application of criteria.

Maximum values with arithmetic returns, as expected, are higher than the ones with log returns. Nevertheless, it would be expected to not to have too large returns due to the price limits regulation in the Borsa Istanbul (based on 10% price limit in one session, maximum change could be 21% on one trading day). Therefore, these large negative and positive returns draw attention to erroneous entries in the database.

Table 6. Size of the Clean Sample with Logarithmic Returns

	Number of securities	Number of returns	Number of zero returns	Proportion of zero returns	Minimum/ Maximum Returns
Raw Data					
	471	1,475,196	527,546	35.76%	-2.66/ 3.27
Clean Sample					
	388	1,381,797	491,540	35.57%	-0.99/ 3.27

Table 7. Size of the Clean Sample with Arithmetic Returns

	Number of securities	Number of returns	Number of zero returns	Proportion of zero returns	Minimum/ Maximum Values
Raw Data					
	471	1,475,196	527,546	35.76%	-0.92/25.42
Clean Sample					
	388	1,381,822*	491,540	35.57%	-0.93/ 6.02

(*) The number of returns for the "clean sample" is not same for log and arithmetic returns. Whenever two clean samples are compared, none of the firms are dropped, and the difference of 25 returns between two samples arises from the outliers: in case of different calculation methods (arithmetic or log returns) one day return may become an outlier and be eliminated in the analysis. These 25 returns are arising due to this calculation difference and application of criteria.

Considering the raw data (before adjustment for the criteria), the distribution of proportion of zero returns is summarized in Figure 2[37]. The proportion of zeros for the firms indexed in BIST-30 is relatively lower since these firms are the 30 firms with the largest market capitalization listed in the National Market (Figure 3). It is important to note that both Figure 2 and 3 are plotted for the raw data before the application of several criteria to have a clean sample.

[37] Figures show the percentage of zero returns for that stock, but not about the length of trading. Therefore, for some stocks for a short period of trading time period there may be infrequent trading.

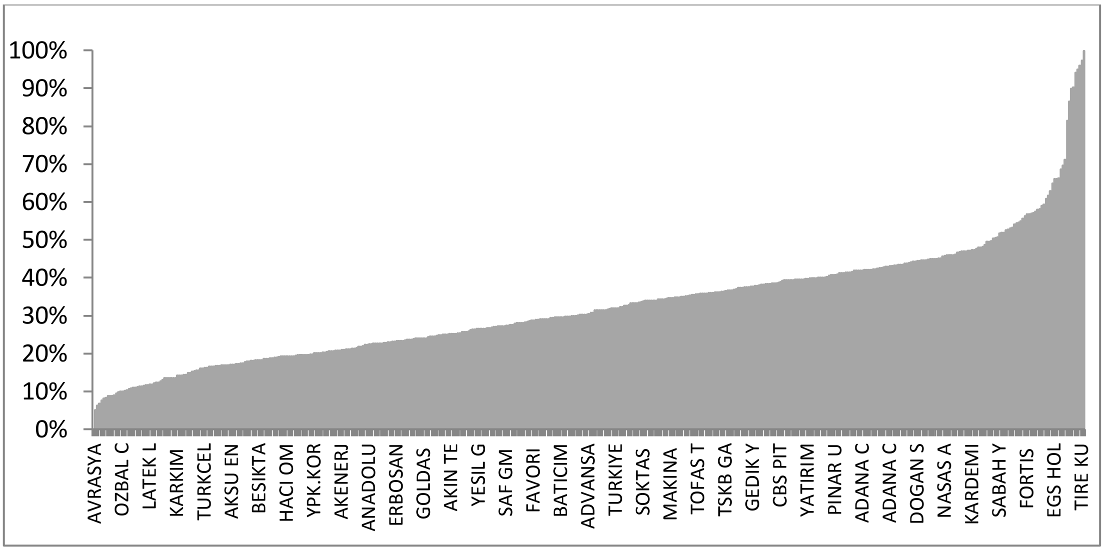

Figure 2. The Proportion of Zeros for Raw Data (471 firms)

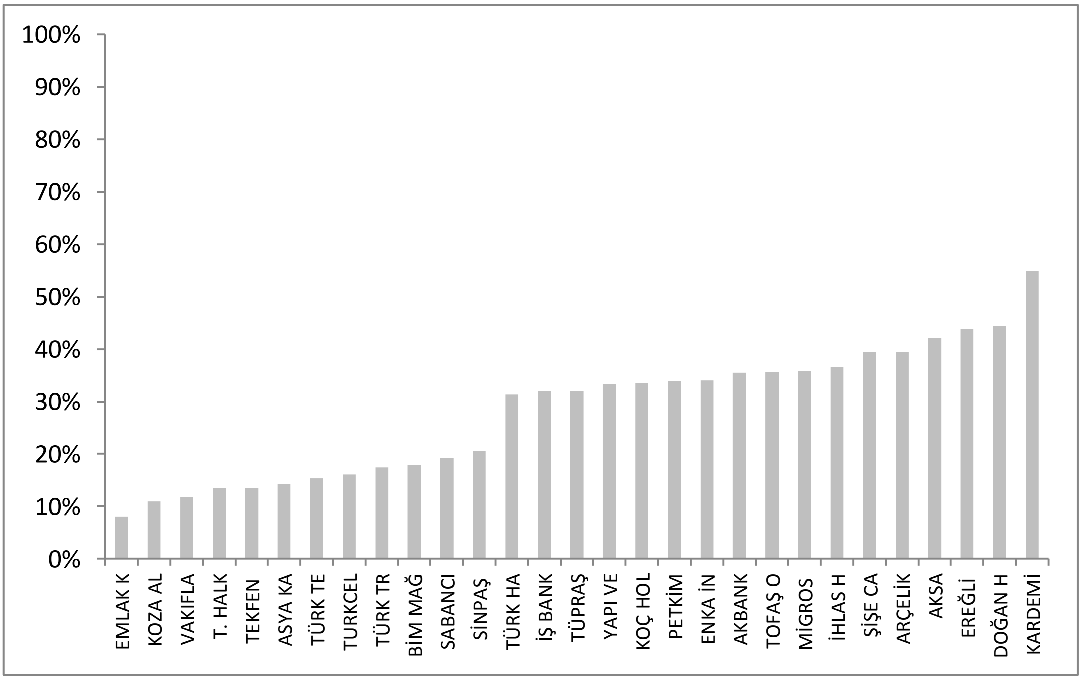

Figure 3. The Proportion of Zeros for Raw Data (BIST-30 firms)

Table 8. Descriptive Statistics for Logarithmic Returns

Performance Measure	Mean	Standard deviation	Skewness[38]	Kurtosis[39]	Jarque-Bera Test[40]
Logarithmic Returns of Raw Data	0.00083	0.05018	0.255	93.827	$541x10^6$
Logarithmic Returns of Clean Sample	0.00088	0.05022	0.844	74.796	$322x10^6$
Mean Adjusted Returns	0.00000	0.05018	0.247	93.831	$506x10^6$
Market Adjusted Returns	-0.00034	0.04812	0.374	108.983	$683x10^6$
Simple Market Model Returns	0.00000	0.04736	0.380	117.666	$797x10^6$

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[38] The skewness characterizes the degree of asymmetry of a distribution around its mean. Positive skewness indicates a distribution with an asymmetric tail extending toward more positive values. Negative skewness indicates a distribution with an asymmetric tail extending toward more negative values. For normal distribution, the skewness should be zero. The equation for skewness is defined as:

$$\frac{n}{(n-1)(n-2)}\sum\left(\frac{x_i-\bar{x}}{std.dev.of\ sample}\right)^3$$

[39] The kurtosis characterizes the relative peakedness or flatness of a distribution compared with the normal distribution. Positive kurtosis indicates a relatively peaked distribution. Negative kurtosis indicates a relatively flat distribution. For normal distribution, the kurtosis should be zero. The kurtosis is calculated as follows:

$$\left\{\frac{n(n+1)}{(n-1)(n-2)(n-3)}\sum\left(\frac{x_i-\bar{x}}{std.dev.of\ sample}\right)^4\right\}-\frac{3(n-1)^2}{(n-2)(n-3)}$$

[40] A formal test of normality, the Jarque-Bera test, uses skewness and kurtosis, which is calculated as follows:

$$JB=\frac{T}{6}\{Skewness^2+Kurtosis^2/4\}$$

As T, number of observations increases, the test statistics follows a chi-square distribution with 2 degrees of freedom.

Table 9. Descriptive Statistics for Arithmetic Returns

Performance Measure	Mean	Standard deviation	Skewness	Kurtosis	Jarque-Bera Test
Arithmetic Returns of Raw Data	0.00212	0.05751	65.949	26,301.248	$42x10^{12}$
Arithmetic Returns of Clean Sample	0.00215	0.05412	9.295	571.584	$18x10^{9}$
Mean Adjusted Returns	0.00000	0.05750	65.928	26,301.542	$39x10^{12}$
Market Adjusted Returns	0.00066	0.05609	74.592	30,593.752	$53x10^{12}$
Simple Market Model Returns	0.00000	0.05542	77.282	32,060.976	$59x10^{12}$

Comparing with the study of Corrado and Truong (2008)[41], proportion of zero returns (approx. 35-36%) is tolerable compared to Malaysia or Singapore, but higher than the US, Japan and Korea. The mean is nearly zero (below 1%) and standard deviation is around 5% similar to other countries (Table 8).

Considering the previous study of Campbell et al. (2009) including Turkey, the percentage of zero returns is 19.4 per cent over 1988-2006. The source is same, Datastream, for 371 firms, but here the percentage of zero returns is higher with 471 firms. Since how Campbell et al. (2009) handle the problems related to the dataset mentioned in Part 3 is unknown, one-to-one comparison of the results cannot be done. One possible explanation for this

[41] In the study of Corrado and Truong (2007), the proportion of zero returns in different exchanges over 1994-2006 are as follows: Australia-ASX, 45.9%; China-SSE, 7.9%; China-SZSE, 7.4%; China-HKEX, 39.2%; India-NSE, 22%; Japan-TSE, 13.5%; Korea-KRX, 12.6%; Malaysia-KLSE, 33.6%; Singapore-SGX, 38%; Taiwan-TSEC, 12.3%; Thailand-SET, 43.8%; United States-NYSE, 11.2%; United States-AMEX, 19%; United States-NASDAQ, 15.1%. In Corrado and Truong (2007), the mean of returns are found as follows:

Country	Mean of Arithmetic Returns	Mean of Logarithmic Returns
Australia	0.00135	-0.00010
Malaysia	0.00028	-0.00036
Shangai	0.00027	-0.00010
Singapore	0.00070	-0.00018
Shen Zhen	0.00034	-0.00005
Taiwan	0.00041	-0.00001
Hong Kong	0.00064	-0.00040
Thailand	0.00034	-0.00049
India	0.00148	0.00040
NYSE	0.00052	0.00013
Japan	0.00215	-0.00010
AMEX	0.00093	-0.00023
Korea	0.00109	-0.00034
NASDAQ	0.00113	-0.00077

difference can be the exclusion of some securities with infrequent trading by Campbell et al. at the first step before conducting the event study. Besides, the mean of returns calculated in Campbell et al. (2009) is 0.004, higher than this dataset. On the other hand, highly non-normal features indicated in Campbell et al. (2009) are supported here. In another study by Muradoğlu and Ünal (1994) the non-normal features of Turkish stock market data is also verified based on serial correlation coefficients, run tests and distributional statistics over 1988-1991. Based on the selected 20 stocks' data (that were traded at least 95 per cent of the days during the period respecting especially for autocorrelation and runs tests), deviations from the weak-form efficiency are explained with probable lack of sophisticated communication both in terms of technology and content of analysis.

Comparing log and arithmetic returns in Table 9, skewness and kurtosis values are more problematic (non-normality problem) for arithmetic returns similar to other countries studied by Corrado and Truong (2008). For arithmetic returns, both the mean and standard deviation are higher similar to results for other countries. Log returns provide functional superiorities such as time additive, continuously compounding properties, but basically as stated in Corrado and Truong (2008), log returns are "sometimes negative and smaller in absolute value, reflecting the symmetric effect of the logarithmic transformation".

5.1 Test Results for Log Returns

Corrado and Truong (2008) claim that the specification error can arise because of the choice of index. Nevertheless, due to the lack of equally weighted index for Turkey the sensitivity of specification to index could not be tested[42], but only comparison of log and arithmetic returns could be done. In order to be able to compare the results with BW, for section 5.1 and 5.2 the estimation window is used as (-244,-1) and event date is described as t=0. Therefore, each artificial abnormal return is added on the event date.

Like BW, the results indicate that the mean adjusted returns do not cause significant specification or power problems (Table 10, 11, 12 and 13). Indeed, in all 4 tests the lowest specification error is obtained with mean adjusted returns where the power of tests is the highest with mean adjusted returns for non-parametric tests. Among only parametric tests, the power of tests is the highest for market model. Therefore, as indicated in BW, mean adjusted returns can be preferred among market adjusted returns and market model without causing a specification problem.

Non-parametric tests (especially the generalized rank test) are expected to outperform the parametric tests as documented in other studies. Campbell and Wasley (1993) for Nasdaq returns, Maynes and Rumsey (1993) for Toronto Stock Exchange, Bartholdy et al. (2007) for the Copenhagen Stock Exchange and Corrado and Truong (2008) for the Asia-Pacific markets state the proper specification of non-parametric tests over parametric ones. Nevertheless, the results from Turkish stock market prevent us making a generalization about the outperformance of non-parametric ones. Comparing the specification errors in order to avoid a severe problem (rejecting the null hypothesis of no abnormal returns when there is no abnormal return), CDA

[42] As indicated in Section 2.2, following the studies conducted for Turkey ISE-100 (BIST-100 with its new name after the establishment of Borsa Istanbul) is used. Other indices such as BIST-ALL index (ISE-ALL index, former name) is not preferred since this index is also a value weighted index, sensitivity to value weighted or equally weighted index would not be observed by using that.

(among the parametric ones) and generalized rank test (among non-parametric ones) seem to provide better results. Therefore, the findings for Borsa Istanbul do not support the findings of Corrado and Truong (2008) since one group of tests cannot dominate the other one. On the other hand, these results support the findings of previous studies (Brown and Warner, 1980; 1985; Collins and Dent, 1984; Dyckman et al., 1984; Jain, 1986; Bernard, 1987; Heinkel and Kraus, 1988) that indicate the good performance of parametric test statistics with good specification and high test power with the New York Stock Exchange even though the non-normality of returns in other exchanges is indicated as a severe problem altering the results.

Table 10. Comparison of Different Procedures with the Crude Dependence Adjustment Test for Log Returns

Method	**Actual Level of Abnormal Performance at day "0"**	
	0%	**1%**
Mean adjusted returns	6.8%	40.0%
Market adjusted returns	8.0%	38.8%
Market Model	8.0%	41.2%

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: mean abnormal performance at day zero = 0%. Sample size=50; one-tailed test; significance level 5%; randomly selected securities and event dates; logarithmic returns. In general for all tests significance level is set 5% and tests are one-sided following Brown and Warner (1980; 1985).

Table 11. Comparison of Different Procedures with the Patell Z-Statistics for Log Returns

Method	Actual Level of Abnormal Performance at day "0"	
	0%	**1%**
Mean adjusted returns	10.8%	63.2%
Market adjusted returns	12.0%	68.4%
Market Model	11.2%	80.8%

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: mean abnormal performance at day zero = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 12. Comparison of Different Procedures with the Generalized Sign Test for Log Returns

Method	Actual Level of Abnormal Performance at day "0"	
	0%	**1%**
Mean adjusted returns	6.8%	97.6%
Market adjusted returns	12.4%	71.2%
Market Model	10.0%	80.4%

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: mean abnormal performance at day zero = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 13. Comparison of Different Procedures with the Generalized Rank Test for Log Returns

Method	Actual Level of Abnormal Performance at day "0"	
	0%	1%
Mean adjusted returns	6.8%	95.6%
Market adjusted returns	10.4%	49.6%
Market Model	8.0%	66.4%

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: mean abnormal performance at day zero = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns.

5.2 Test Results for Arithmetic Returns

The results are very close to the results for log returns. Still mean adjusted returns do not cause a significant problem, and the lowest specification error is attained with mean adjusted returns. Similar to log returns, mean adjusted returns yield the highest power for non-parametric tests.

Comparing the specification error and power of tests for log and arithmetic returns, for parametric tests the specification errors but also the powers of tests are lower with arithmetic returns. On the other hand, for non-parametric tests, there are some changes in both directions in specification error and power preventing to generalize the results. Therefore, the test results for log results cannot dominate those for arithmetic returns for all tests under different performance models (Table 14, 15, 16 and 17). From the point of the specification error, still the CDA and generalized rank tests are comparatively well-specified tests.

Considering Table 14, BW makes a similar table with arithmetic returns for crude dependence test. The difference between these two tables indicates that in Turkish market the specification error of tests is a little bit larger and the power of tests is lower. As shown at the note of Table 14, it is shown that after adding 0.5 per cent artificial return on event date in Turkish stock market the power of tests rises to around 15 per cent whereas in BW the CDA test is able to detect 0.5 per cent artificial return with 25 per cent probability on average. Even after adding 2 per cent abnormal artificial return at time zero, the power of tests is still around 85 per cent whereas BW indicate nearly 100 per cent. In other words, in BW nearly with 100 per cent probability the CDA test is able to detect the abnormal return when there is actually is, but this probability goes down to around 85 per cent for Turkey. One possible explanation for this finding can be the difference between the US and Turkish markets, which necessitate applying further methods for Turkey that would result in lower specification error and higher power even though there is not a big gap between the results.

Table 14. Comparison of Different Procedures with the Crude Dependence Adjustment Test for Arithmetic Returns

Method	Actual Level of Abnormal Performance at day "0"	
	0%	**1%**
Mean adjusted returns	6.0%	32.8%
Market adjusted returns	7.2%	37.2%
Market Model	7.6%	34.4%

Notes:

1- Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: mean abnormal performance at day zero = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns.

2- Brown and Warner (1985) use the same test, Crude Dependence Test, to compare different procedures. The results for the comparison of different procedures for detecting abnormal performance: Percentage of 250 samples where the null hypothesis is rejected. H_0: mean abnormal performance at day zero = 0%; sample size=50; one-tailed test; significance level 5%; randomly selected securities and event dates; arithmetic returns; time period 1962-1979:

Method	**Actual Level of Abnormal Performance at day "0"**			
BW Results	**0%**	**0.5%**	**1%**	**2%**
Mean adjusted returns	6.4%	25.2%	75.6%	99.6%
Market adjusted returns	4.8%	26.0%	79.6%	99.6%
Market Model	4.4%	27.2%	80.4%	99.6%
Results for Turkish Stock Market	**0%**	**0.5%**	**1%**	**2%**
Mean adjusted returns	6.0%	15.2%	32.8%	81.2%
Market adjusted returns	7.2%	16.8%	37.2%	88.4%
Market Model	7.6%	13.2%	34.4%	84.8%

Table 15. Comparison of Different Procedures with the Patell Z-Statistics for Arithmetic Returns

Method	Actual Level of Abnormal Performance at day "0"	
	0%	1%
Mean adjusted returns	10.0%	62.8%
Market adjusted returns	10.0%	70.8%
Market Model	10.4%	78.8%

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: mean abnormal performance at day zero = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns.

Table 16. Comparison of Different Procedures with the Generalized Sign Test for Arithmetic Returns

Method	Actual Level of Abnormal Performance at day "0"	
	0%	1%
Mean adjusted returns	7.2%	99.2%
Market adjusted returns	12.4%	71.2%
Market Model	12.8%	81.6%

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: mean abnormal performance at day zero = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns.

Table 17. Comparison of Different Procedures with the Generalized Rank Test for Arithmetic Returns

Method	Actual Level of Abnormal Performance at day "0"	
	0%	**1%**
Mean adjusted returns	6.8%	95.6%
Market adjusted returns	10.4%	49.6%
Market Model	8.4%	64.8%

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: mean abnormal performance at day zero = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns.

CHAPTER 6

SENSITIVITY ANALYSIS

In this section different parameters (sample size, length of event period, clustering, different time periods, databases and other important issues such as the impact of a crisis) are considered in order to examine how sensitive the results are to these factors.

6.1 Test Results for Sample Size Sensitivity

As using an estimation window of (-244,-6) and event window of (-5,+5), whenever the sample size decreases from 50 securities to 20 securities, there is a slight decrease in the specification error, but power of tests significantly decreases with samples of 20 securities (Table 18, 19, 20 and 21). As expected[43], there is no significant gain in the specification error, but the power of tests dramatically changes, similar to the findings in BW. Especially with the crude dependence adjustment and generalized rank tests, the change in power is severe (Table 18 and 21). For all tests the power of tests decreases whenever the sample size is smaller (i.e., strictly increasing function). Therefore, the samples of 50 securities should be preferred over samples of 20 securities. As designing random samples at least samples composed of 50 securities should be chosen.

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[43] Kothari and Warner (2006) indicate that (as expected) as the sample size gets larger, so does the power of tests.

Table 18. Comparison of Procedures with the Crude Dependence Adjustment Test for Log Returns and Different Sample Sizes

Method	Sample Size	Event Window (-5,+5)	
		0	**5%**
Mean adjusted returns	**Sample of 50 securities**	10%	68%
	Sample of 20 securities	4%	36%
Market adjusted returns	**Sample of 50 securities**	8%	66%
	Sample of 20 securities	4%	40%
Market Model	**Sample of 50 securities**	6%	71%
	Sample of 20 securities	4%	41%

Note: Comparison of different procedures for detecting abnormal performance for different sample sizes with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 19. Comparison of Procedures with the Patell Z-Statistics for Log Returns and Different Sample Sizes

Method	Sample Size	Event Window (-5,+5)	
		0	**5%**
Mean adjusted returns	**Sample of 50 securities**	19%	88%
	Sample of 20 securities	12%	62%
Market adjusted returns	**Sample of 50 securities**	16%	95%
	Sample of 20 securities	10%	70%
Market Model	**Sample of 50 securities**	12%	96%
	Sample of 20 securities	8%	74%

Note: Comparison of different procedures for detecting abnormal performance for different sample sizes with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 20. Comparison of Procedures with the Generalized Sign Test for Log Returns and Different Sample Sizes

Method	Sample Size	Event Window (-5,+5)	
		0	5%
Mean adjusted returns	Sample of 50 securities	20%	96%
	Sample of 20 securities	10%	78%
Market adjusted returns	Sample of 50 securities	12%	99%
	Sample of 20 securities	13%	79%
Market Model	Sample of 50 securities	13%	98%
	Sample of 20 securities	12%	83%

Note: Comparison of different procedures for detecting abnormal performance for different sample sizes with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 21. Comparison of Procedures with the Generalized Rank Test for Log Returns and Different Sample Sizes

Method	Sample Size	Actual Level of Abnormal Performance at day "0"	
		0	5%
Mean adjusted returns	Sample of 50 securities	10%	73%
	Sample of 20 securities	10%	41%
Market adjusted returns	Sample of 50 securities	8%	76%
	Sample of 20 securities	7%	46%
Market Model	Sample of 50 securities	6%	75%
	Sample of 20 securities	9%	47%

Note: Comparison of different procedures for detecting abnormal performance for different sample sizes with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Significance level 5%; randomly selected securities and event dates; logarithmic returns.

6.2 Test Results for Event Period Sensitivity

Comparison of the lengths of event windows is crucial since the underlying assumption of the event studies of corporate announcements is generally the learning of the related information by the investors within the defined short-term. However, in case of information leakages or predictions and anticipations about the events, event study results or methods used may change.

In a study by Edmans et al. (2009) the dual relationship between the financial markets and corporate events (i.e., feedback loop) is investigated, and after constructing a value discount model the tests for the feedback loop indicate that high discounts invite takeovers, but market anticipation causes the discount to shrink. Negative impact of anticipation effect is explained such that financial efficiency may hinder real efficiency. Cornett et al. (2011) also examine the impact of investors' anticipation of bidder and target merger candidacy on the returns. It is indicated that investors can predict the bidder firms more successfully than target firms. Therefore, higher CARs for target firms compared to bidder CARs are explained with the difference in the freshness of information. After controlling for the predictably, a difference between the bidder and target firm three-day cumulative abnormal returns is found out to be decreasing around a merger announcement. This evidence is used to support the unequal abnormal returns for bidder and target around the announcement due to the anticipation.

A recent study by Mulherin and Simsir (2013) draws attention to the importance of definition of a "proper event window". The abnormal returns around the "date announced" (DA) field as the event date for the merger announcement in the Securities Data Corporation database is compared with the "original date announced" (ODA) created with the merger-related events. The results show that target firms' stock prices increase by an average of 12.6 per cent around the ODA over (-1,+1) and another 11 per cent around the DA over three-day period marking the severity of the accuracy of the ODA in capturing the impact of merger announcements.

Additionally, articles on the conditional event-study methods (Acharya, 1988; 1993; Eckbo et al., 1990) claim that the firms voluntarily make choices for corporate events, and initiate when firms aims to declare this unknown information to the market. The unexpected portion of this information would make the effect on prices. Parabhala (1997) states that the conditional methods would have a significant value added only in case the researcher has a set of non-event firms, which were partially anticipated to be announced, but chosen not to be announced. However, in most of the cases the non-event data is not available, so that traditional cross-sectional procedure together with the t-statistics can be used.

In this section, event window of (-5,+5) is compared with one-day event window and (-1,+1) and in order to test the impact on the specification error and power of tests. As comparing the results for the Turkish stock market and BW, the basic difference is the introduction of the event date. In the studies of BW, the abnormal performance is introduced on one random day over the 11-day interval (-5,+5) with each day having an equal probability of selection. However, in this study the abnormal returns are introduced at time zero over both (-5,+5) and (-1,+1). Therefore, for all cases it is known that the artificial abnormal return exists at time zero. Since the tests would rely on the cumulative abnormal returns, this difference in design would be expected to have a minor impact on the results.

According to the logarithmic returns' results, relatively well-specified tests are still the crude dependence and generalized rank tests (Table 22 and 25). As indicated in BW, there is not a big change in specification error, but power of tests increase considerably in all cases whenever the event window shortens (Table 22, 23, 24 and 25).

In the note of Table 26, BW results (for the CDA test with arithmetic returns) are compared to those for Turkey one-to-one, and shorter event windows are again found appropriate from the point of power of tests, but not for specification purposes. It is important to note that as observing different event windows together with the change in the specification error; the specification errors for the Turkish Stock Market are a little bit higher (around 2-4 per cent) than those in the BW indicating that the need for a better fitting model for Turkey[44].

[44] The results for arithmetic returns also confirm the results for log returns (Table 26, 27, 28 and 29). Considering the note of Table 26, in BW's study there is not a gain in specification error whenever the event window is composed only one day instead of 11 days. On the other hand, there is a dramatic increase in the power.

Table 22. Comparison of Procedures with the Crude Dependence Adjustment Test for Log Returns and Different Event Windows

Method	**Days in event period**	**Over Different Event Window**	
		0	**5%**
Mean adjusted returns	**11 (-5,+5)**	10%	68%
	3 (-1,+1)	10%	98%
	1 (t=0)	7%	100%
Market adjusted returns	**11 (-5,+5)**	8%	66%
	3 (-1,+1)	8%	99%
	1 (t=0)	8%	100%
Market Model	**11 (-5,+5)**	6%	71%
	3 (-1,+1)	10%	99%
	1 (t=0)	8%	100%

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 23. Comparison of Procedures with the Patell Z-Statistics for Log Returns and Different Event Windows

Method	Days in event period	Over Different Event Windows	
		0	5%
Mean adjusted returns	**11 (-5,+5)**	19%	88%
	3 (-1,+1)	19%	100%
	1 (t=0)	11%	100%
Market adjusted returns	**11 (-5,+5)**	15%	95%
	3 (-1,+1)	16%	100%
	1 (t=0)	12%	100%
Market Model	**11 (-5,+5)**	12%	96%
	3 (-1,+1)	12%	100%
	1 (t=0)	11%	100%

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 24. Comparison of Procedures with the Generalized Sign Test for Log Returns and Different Event Windows

Method	Days in event period	Over Different Event Windows	
		0	5%
Mean adjusted returns	**11 (-5,+5)**	20%	96%
	3 (-1,+1)	16%	100%
	1 (t=0)	7%	100%
Market adjusted returns	**11 (-5,+5)**	12%	99%
	3 (-1,+1)	14%	100%
	1 (t=0)	12%	100%
Market Model	**11 (-5,+5)**	13%	98%
	3 (-1,+1)	11%	100%
	1 (t=0)	10%	100%

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 25. Comparison of Procedures with the Generalized Rank Test for Log Returns and Different Event Windows

Method	Days in event period	Over Different Event Windows	
		0	5%
Mean adjusted returns	11 (-5,+5)	10%	73%
	3 (-1,+1)	10%	100%
	1 (t=0)	7%	100%
Market adjusted returns	11 (-5,+5)	8%	76%
	3 (-1,+1)	8%	100%
	1 (t=0)	10%	100%
Market Model	11 (-5,+5)	6%	75%
	3 (-1,+1)	8%	100%
	1 (t=0)	8%	100%

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 26. Comparison of Procedures with the Crude Dependence Adjustment Test for Arithmetic Returns and Different Event Windows

Method	Days in event period	Over Different Event Windows	
		0	**5%**
Mean adjusted returns	**11 (-5,+5)**	11%	62%
	3 (-1,+1)	11%	98%
	1 (t=0)	6%	100%
Market adjusted returns	**11 (-5,+5)**	7%	72%
	3 (-1,+1)	11%	99%
	1 (t=0)	7%	100%
Market Model	**11 (-5,+5)**	6%	63%
	3 (-1,+1)	10%	99%
	1 (t=0)	8%	100%

Notes:

1- Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns.

2- Brown and Warner (1985) use the same test, Crude Dependence Test, to compare different procedures when the event period is just one day. For each security, abnormal performance is introduced for one day m the 11-day interval (- 5, +5) with each day having an equal probability of selection. The null hypothesis is that the cumulative mean excess return in the interval (-5, +5) = 0. Then, for 1 day event periods for each security abnormal performance is introduced at day"0" over (-5, +5). The BW results for the comparison of different procedures for detecting abnormal performance: Percentage of 250 samples where the null hypothesis is rejected. H_0: mean abnormal performance at day zero = 0%; sample size=50; one-tailed test; significance level 5%; randomly selected securities and event dates; arithmetic returns; time period 1962-1979.

Method	Days in event period	Actual Level of Abnormal Performance of…	
		0	**1%**
BW Results			
Mean adjusted returns	11 1	4.0% 6.4%	13.6% 75.6%
Market adjusted returns	11 1	4.0% 4.8%	13.2% 79.6%
Market Model	11 1	2.8% 4.4%	13.2% 80.4%

Table 27. Comparison of Procedures with the Patell Z-Statistics for Arithmetic Returns and Different Event Windows

Method	Days in event period	Over Different Event Windows	
		0	5%
Mean adjusted returns	**11 (-5,+5)**	18%	88%
	3 (-1,+1)	16%	100%
	1 (t=0)	10%	100%
Market adjusted returns	**11 (-5,+5)**	13%	98%
	3 (-1,+1)	15%	100%
	1 (t=0)	10%	100%
Market Model	**11 (-5,+5)**	13%	96%
	3 (-1,+1)	15%	100%
	1 (t=0)	10%	100%

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns.

Table 28. Comparison of Procedures with the Generalized Sign Test for Arithmetic Returns and Different Event Windows

	Days in event period	Over Different Event Windows	
		0	**5%**
Mean adjusted returns	**11 (-5,+5)**	24%	98%
	3 (-1,+1)	20%	100%
	1 (t=0)	7%	100%
Market adjusted returns	**11 (-5,+5)**	16%	99%
	3 (-1,+1)	13%	100%
	1 (t=0)	12%	100%
Market Model	**11 (-5,+5)**	11%	98%
	3 (-1,+1)	10%	100%
	1 (t=0)	13%	100%

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns.

Table 29. Comparison of Procedures with the Generalized Rank Test for Arithmetic Returns and Different Event Windows

Method	Days in event period	Over Different Event Windows	
		0	5%
Mean adjusted returns	**11 (-5,+5)**	10%	73%
	3 (-1,+1)	10%	100%
	1 (t=0)	7%	100%
Market adjusted returns	**11 (-5,+5)**	7%	76%
	3 (-1,+1)	9%	100%
	1 (t=0)	10%	100%
Market Model	**11 (-5,+5)**	6%	74%
	3 (-1,+1)	9%	100%
	1 (t=0)	8%	100%

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns.

6.3 Test Results for Clustering

Clustering refers restricting the same event date for all securities in a given sample. In this thesis, the hypothetical but restricted event dates are randomly chosen without replacement contrary to the previous analysis where the companies are selected with replacement.

The analysis of the clustering has important implications for the structure of the market. If the clustering problem does not alter the results of tests, this would imply that investigation of any event affecting all firms at a special date (such as the announcements of the Central Bank) can be done by the event study without any methodological problem. Such an implication would have significant impact on ongoing studies as well as the future path of studies related to the Turkish Stock Market data.

Under the clustering with logarithmic and arithmetic returns, both the specification error dramatically rises and the power of tests significantly decreases (Table 30, 31, 32, 33 for logarithmic returns and Table 34, 35, 36 and 37 for arithmetic returns). Only for one case (crude dependence test with logarithmic returns and market adjusted returns), the specification error is nearly same with or without clustering.

In Table 34, BW's findings are also inserted where under clustering problem mean adjusted returns yield considerably high specification error. Therefore, BW recommend to use market model returns under clustering problem. This finding is also supported with the Turkish stock market data: there is a significant deterioration in specification error whenever mean adjusted returns are used. Therefore, market model or at least market adjusted returns should be used to test the events in case of clustering in order to specify the Turkish Stock Market.

Comparing the tests, the CDA test is comparatively the well-specified test where especially with Patell test (66% specification error with log returns and 68% with arithmetic returns) and generalized sign test (75% specification error with log returns and 73% with arithmetic returns) the specification error is too high to be used.

The results for clustering imply that clustering significantly alters the results, and hence clustering is a severe problem that should be avoided in the Turkish stock market. To illustrate; a researcher willing to investigate the impact of the inflation announcements or macroeconomic events on stock returns that would affect stocks on the same date should not use the mean adjusted returns to test the significance of abnormal returns. Mean adjusted returns cannot perform well under clustering problem, so that market model or at least the market adjusted returns should be used for the Turkish stock market data.

Table 30. Comparison of Procedures with/out Clustering with the Crude Dependence Adjustment Test for Log Returns

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	5%
Mean adjusted returns	Non-Clustering	10%	68%
	Clustering	15%	26%
Market adjusted returns	Non-Clustering	8%	66%
	Clustering	7%	28%
Market Model	Non-Clustering	6%	71%
	Clustering	9%	38%

Note: Percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 31. Comparison of Procedures with/out Clustering with the Patell Z-Statistics for Log Returns

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	5%
Mean adjusted returns	Non-Clustering	19%	88%
	Clustering	66%	77%
Market adjusted returns	Non-Clustering	16%	95%
	Clustering	37%	70%
Market Model	Non-Clustering	12%	96%
	Clustering	40%	77%

Note: Percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 32. Comparison of Procedures with/out Clustering with the Generalized Sign Test for Log Returns

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	5%
Mean adjusted returns	Non-Clustering	20%	96%
	Clustering	75%	87%
Market adjusted returns	Non-Clustering	12%	99%
	Clustering	57%	84%
Market Model	Non-Clustering	13%	98%
	Clustering	46%	88%

Note: Percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 33. Comparison of Procedures with/out Clustering with the Generalized Rank Test for Log Returns

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	5%
Mean adjusted returns	Non-Clustering	10%	73%
	Clustering	19%	30%
Market adjusted returns	Non-Clustering	8%	76%
	Clustering	10%	23%
Market Model	Non-Clustering	6%	75%
	Clustering	13%	28%

Note: Percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; logarithmic returns.

Table 34. Comparison of Procedures with/out Clustering with the Crude Dependence Adjustment Test for Arithmetic Returns

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	5%
Mean adjusted returns	Non-Clustering	11%	62%
	Clustering	16%	26%
Market adjusted returns	Non-Clustering	7%	72%
	Clustering	9%	41%
Market Model	Non-Clustering	6%	63%
	Clustering	10%	36%

Notes:

1- Percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; arithmetic returns.

2- Brown and Warner (1985) use the same test, Crude Dependence Test, to compare different procedures under the effect of event-day clustering. The table shows the percentage of 250 samples where the null hypothesis is rejected. For a given sample, day '0' is the same calendar date for each security. The calendar day differs from sample to sample. H_0: cumulative mean daily abnormal performance in the interval (- 5. + 5) = 0. H_0: mean abnormal performance at day zero = 0%; sample size=50; one-tailed test; significance level 5%; randomly selected securities and event dates; arithmetic returns; time period 1962-1979:

Method		Actual Level of Abnormal Performance over (-5,+5)	
		0	2%
		BW results	
Mean adjusted returns	Non-clustering	4.0%	37.6%
	Clustering	13.6%	29.6%
Market adjusted returns	Non-clustering	4.0%	32.0%
	Clustering	4.0%	46.0%
Market Model	Non-clustering	2.8%	37.2%
	Clustering	3.2%	46.0%

Table 35. Comparison of Procedures with/out Clustering with the Patell Z-Statistics for Arithmetic Returns

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	5%
Mean adjusted returns	Non-Clustering	18%	88%
	Clustering	68%	73%
Market adjusted returns	Non-Clustering	13%	98%
	Clustering	40%	80%
Market Model	Non-Clustering	13%	96%
	Clustering	39%	78%

Note: Percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; arithmetic returns.

Table 36. Comparison of Procedures with/out Clustering with the Generalized Sign Test for Arithmetic Returns

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	5%
Mean adjusted returns	Non-Clustering	24%	98%
	Clustering	73%	89%
Market adjusted returns	Non-Clustering	16%	99%
	Clustering	55%	85%
Market Model	Non-Clustering	11%	98%
	Clustering	44%	86%

Note: Percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; arithmetic returns.

Table 37. Comparison of Procedures with/out Clustering with the Generalized Rank Test for Arithmetic Returns

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	5%
Mean adjusted returns	Non-Clustering	10%	73%
	Clustering	18%	30%
Market adjusted returns	Non-Clustering	7%	76%
	Clustering	10%	23%
Market Model	Non-Clustering	6%	74%
	Clustering	14%	28%

Note: Percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; arithmetic returns.

6.4 Test Results for 1999-2012 Period: Period with Short Selling and Margin Trading

Considering the history of the ISE the milestones related to the trading of equities can be listed as follows[45]:

Table 38. Cornerstones in ISE History

Year	Cornerstones in ISE
2013	April: Following the new Capital Market Law numbered 6362 and came into force on December 30, 2012; Borsa Istanbul is established with the aim of consolidating all exchanges under one roof. Borsa Istanbul is officially registered and started its operations on April 3, 2013.
2011	January: ISE Automatic Circuit Breaker System came into force on January 10, 2011. April: New regulation on the sale methods in the Primary Market to be initially listed on the Exchange. •Book Building and Sale with a Fixed Price Method (Fixed Price Method) •Book Building and Sale with Variable Price Method (Variable Price Method) July: ISE launched the Dividend Indices
2010	May-December: IPO Summit Turkey July: Inauguration of Continuous Auction via Market Making Trading Mechanism July: Inspection and Surveillance Board prepared an Action Plan for Efficient Surveillance in the beginning of 2010, and "Automatic Circuit Breaker System" has been introduced as an integral part of the said Action Plan. The mechanism is called ISE Automated Circuit Breaker System, and adopted by the CMB, it is an integral part of the new trading measures introduced for the Equity Market dated July 23, 2010. October-November: Stocks started to be traded as classified into A, B, C groups, Implementation of Unconditional Order Cancellation, Initiation of

[45] http://www.ise.org/AboutUs/History.aspx?sfopl=true

Table 38 (cont'd)

	Phase I of Reducement in Price Ticks
2009	February: City Indices launched for 9 cities March: The Emerging Companies Market was established. May: Public Disclosure Platform launched August: ISE Emerging Companies Market Regulation was published.
2007	August: ISE started to calculate the Corporate Governance Index.
2006	December: As of December 27, 2006, the ISE International Market and its submarkets (Depositary Receipts Market and International Market Bonds and Bills Market) were closed.
2005	February: ISE Executive Council has decided to launch a new index namely "ISE Corporate Governance Index".
2004	November: The "ETFs Market" was established with an aim to provide an organized and transparent market for trading of participation certificates of the ETFs.
2003	March: All orders submitted to the Stock Market for all stocks and during all sessions have been required to include customer account numbers. March: Regional Markets and New Companies Market were renamed as Second National Market and New Economy Market, respectively.
2002	August: Stocks of companies, trading of which were suspended by the ISE for the reason that the disclosure requirements have not been fulfilled resulting with uncertainties preventing the formation of a health market, started to be traded off-exchange in line with the regulations entitled "Principles concerning off-exchange trading of stocks exchange trading of which have been suspended by the ISE" published on July 19, 2004.
2001	December: Transition to Ex-API system within the framework of the Wide Area Network has started gradually.
2000	July: Within the context of Wide Area Network Project, trading at the ISE's Stock Market via workstations located at the headquarters of ISE members started on July 31, 2000.
1999	January: ISE started to calculate ISE 100 Index on Euro basis. May: ISE Settlement and Custody Bank (Takasbank) introduced the client name-based custody system. **August: Starting from August 24, 1999, short-selling transactions and margin trading became available in all stocks traded on the ISE's markets. Previously, authorized ISE members had the opportunity to engage in short-selling transactions only in stocks constituting the ISE-National 100 Index.**
1997	January: Introduction of new Stock Market indices as integers with the drop of two digits from base values.

Table 38 (cont'd)

1996	January: Initiation of banking services of the ISE Settlement and Custody Bank July: Accepting of the applications for listing and trading on the ISE International Market.
1995	January: Launch of the Regional Markets and the Wholesale Market March: Initiation of Custody Services on customer basis by the ISE Settlement and Custody Company April: Disclosure of detailed balance sheet and income statements of companies including footnotes April: Initiation of short selling transactions April: Launch of the New Companies Market May: Establishment of Investor Counseling Center designed to provide information on the ISE's operations and traded companies July: Transformation of the ISE Settlement and Custody Company into the ISE Settlement and Custody Bank (Takasbank)
1994	**September: Initiation of Small Orders Market in the Bonds and Bills Market** **November: Full automation of stock trading**
1993	January: Launch of the Rights Coupon Market and New Shares Market December: Initiation of computerized stock trading with 50 stocks
1992	January: Transformation of the Settlement and Custody Center into an independent company
1991	January: Commencement of the calculation of Financials and Industrials Indices in addition to the ISE Composite Index June: Initiation of the Bonds and Bills Market and commencement of Outright Purchases and Sales Transactions
1989	July: Establishment of the Settlement and Custody Center August: Issuance of Decree 32 which allows foreign investors to purchase and sell all types of securities in Turkey and repatriate the proceeds
1987	October: Commencement of daily calculation of ISE Indices which had so far been calculated on a weekly basis November: Moving to the new building in Karakoy and initiation of the Manual Board System December: External auditing of listed companies required
1986	January: Commencement of stock trading at the Cagaloglu building on January 3, 1986
1985	December: Inauguration of the ISE under the Chairmanship of Mr. Muharrem KARSLI

Based on these milestones, especially full automation of trading in 1994 and allowance of margin trading and short selling in the markets in 1999 are considered as major breaks. Especially, after 1999 several developments have experienced including the creation of an ETF market, calculation of different indices, and automatic circuit breakers. Therefore, same tests are carried out for this sub-period: September, 1999 - February, 2012.

For the sample period of 09.01.1999-02.24.2012, a total number of 1,033,941 returns of 449 securities[46] are gathered. Nevertheless, after applying all criteria, 962,995 log returns of 354 firms are used as the clean sample (Table 39). The estimation window is defined as (-244,-6) where the event window is described as (-5,+5).

As shortening the time period from 1988-2012 to 1999-2012, it would be expected to have a less volatile dataset with lower percentage of zero returns. The descriptive statistics confirm these expectations; the standard deviations are lower. Compared to whole dataset starting from 1988, the percentage of zero returns is lower around 26% in contrary to 35% in the original dataset. As expected, since the data is more recent with less non-missing data, the mean of returns are lower as well as the standard deviations (Table 41).

[46] Compared to the initial dataset, 22 securities dropped as shrinking the time period.

Table 39. Size of the Sample with Logarithmic Returns over 1999-2012

	Number of securities	Number of returns	Number of zero returns	Proportion of zero returns
Raw Data				
	449	1,033,941	270,453	26.16%
Clean Sample				
	354	962,995	247,910	25.74%

Table 40. Size of the Sample with Arithmetic Returns over 1999-2012

	Number of securities	Number of returns	Number of zero returns	Proportion of zero returns
Raw Data				
	449	1,033,941	270,453	26.16%
Clean Sample				
	354	963,006	247,910	25.74%

Table 41. Descriptive Statistics for Logarithmic Returns over 1999-2012

Performance Measure	Mean	Standard deviation	Skewness	Kurtosis	Jarque-Bera Test
Logarithmic Returns of Raw Data	0.00058	0.03665	0.038	95.094	$389x10^6$
Logarithmic Returns of Clean Sample	0.00062	0.03640	0.949	39.884	$63x10^6$
Mean Adjusted Returns	0.00000	0.03664	0.036	95.104	$362x10^6$
Market Adjusted Returns	-0.00012	0.03296	0.308	142.879	$819x10^6$
Simple Market Model Returns	0.00000	0.03202	0.293	159.797	$1,024x10^6$

Table 42. Descriptive Statistics for Arithmetic Returns over 1999-2012

Performance Measure	Mean	Standard deviation	Skewness	Kurtosis	Jarque-Bera Test
Arithmetic Returns of Raw Data	0.00126	0.03847	13.672	1788.0545	$137x10^9$
Arithmetic Returns of Clean Sample	0.00128	0.03838	12.204	1618.223	$105x10^9$
Mean Adjusted Returns	0.00000	0.03846	13.655	1786.419	$128x10^9$
Market Adjusted Returns	0.00028	0.03506	18.156	2604.959	$272x10^9$
Simple Market Model Returns	0.00000	0.03414	19.592	2884.296	$333x10^9$

Considering the test results, there is not a significant improvement in the specification error (Table 43, 44, 45 and 46) as shortening the time period over recent years. Indeed, there is a dramatic deterioration for the generalized rank test. On the other hand, there is an increase in the power of tests except the generalized rank test. An increase in power is also a result of the decrease in the standard deviations. The most powerful tests are Patell Z and generalized sign test.

Similar to the results found for the whole dataset covering longer time period, crude dependence test is well specified compared to other tests whereas the generalized rank test is not any more. The highest specification error for the generalized rank test indicates that over 1999-2012 this non-parametric should not be preferred. One of the explanations for this change can be an increase in the return variance over the recent time period (Cowan, 1992). Serra (2002) mentions that the parametric tests may perform even better than the rank test under return variance increases –specifically, whenever misspecification problem arises. Cowan and Sergeant (1996) also support the specification error of rank test under variance increases.

To sum up, even though the specification errors and power of tests are close to each other under different methods, in general market model yields the lowest specification error and highest power[47] for tests over 1999-2012 in the Turkish stock market.

[47] Only for the generalized rank test, the misspecification of market model is 2-3 per cent higher than the market adjusted returns.

Table 43. Comparison of Procedures with the Crude Dependence Adjustment Test for Log Returns over 1999-2012

Method	Event Window (-5,+5)	
	0	5%
Mean adjusted returns	10% / 11% **8% / 8%**	68% / 62% **81% / 74%**
Market adjusted returns	8% / 7% **6% / 8%**	66% / 72% **93% / 94%**
Market Model	6% / 6% **6% / 6%**	71% / 63% **91% / 84%**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; one-tailed test; significance level 5%; randomly selected securities and event dates; logarithmic returns/arithmetic returns; 1999-2012 period results are given in bold & underlined at the second line whereas 1988-2012 period results are given at the first line.

Table 44. Comparison of Procedures with the Patell Z-Statistics for Log Returns over 1999-2012

Method	Event Window (-5,+5)	
	0	5%
Mean adjusted returns	19% / 18% **17% / 17%**	88% / 88% **93% / 94%**
Market adjusted returns	16% / 13% **15% / 13%**	95% / 98% **99% / 100%**
Market Model	12% / 13% **13% / 14%**	96% / 96% **100% / 100%**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns/arithmetic returns; 1999-2012 period results are given in bold & underlined at the second line whereas 1988-2012 period results are given at the first line.

Table 45. Comparison of Procedures with the Generalized Sign Test for Log Returns over 1999-2012

Method	Event Window (-5,+5)	
	0	5%
Mean adjusted returns	20% / 24% **13% / 13%**	96% / 98% **96% / 97%**
Market adjusted returns	12% / 16% **15% / 16%**	99% / 99% **99% / 99%**
Market Model	13% / 11% **10% / 11%**	98% / 98% **100% / 100%**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns/arithmetic returns; 1999-2012 period results are given in bold & underlined at the second line whereas 1988-2012 period results are given at the first line.

Table 46. Comparison of Procedures with the Generalized Rank Test for Log Returns over 1999-2012

Method	Event Window (-5,+5)	
	0	5%
Mean adjusted returns	10% / 10% **26% / 26%**	73% / 73% **34% / 34%**
Market adjusted returns	8% / 7% **17% / 18%**	76% / 76% **52% / 52%**
Market Model	6% / 6% **20% / 20%**	75% / 74% **50% / 50%**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns/arithmetic returns; 1999-2012 period results are given in bold & underlined at the second line whereas 1988-2012 period results are given at the first line.

6.5 Comparison with the Database of Matriks

Matriks[48], one of the domestic information distributors of Borsa Istanbul, also disseminates corrected price data. Even though each database uses its own methodology for correcting the prices, the historical data of Matriks is also used as an alternative to Datastream. Since the correction of prices based on the corporate events is done specific to the database, the prices provided by these parties do not coincide all the time. To illustrate; for ADEL the first price value is on June 18, 1996 is 0.28 at Datastream, but 0.11 at Matriks database.

The basic drawback of historical prices used by Matriks is that only the recent traded securities are included in the database. Therefore, the securities, which do not survive anymore, are not listed. The Datastream provides information on 471 securities (this number drops to 388 for the log returns case) whereas Matriks historical prices include information on 396 firms (dropping to 307 firms for the log returns case). Consequently, the outcomes for these two databases should not be considered as one-to-one substitutes.

Another crucial thing is that there are some differences between Datastream and Matriks, apart from the methodology. To illustrate; for the equity "ACIBD" the first trading date is June 15, 2000 at the Matriks database

[48] Matriks Bilgi Dağıtım Hizmetleri A.Ş. ("Matriks") was established in August 2003. It has been serving as a "Licensed Data Dissemination Company" since January 2004, upon receiving a Buyer's License from the Exchange. Matriks is a technology-oriented company, extracting useful information from data on Turkish and global capital markets into and conveying such information to individual and institutional clients, using every possible medium. Employing an unparalelled in-house software development team of 12 experts, Matriks develops individualized software solutions to meet the varying needs of professional and amateur clients for data dissemination, data feeds and analysis tools.

whereas this date is July 6, 2000 at the Datastream database. When the files of Borsa Istanbul are observed, it is stated that first trading day of ACIBD was June 15, 2000. Therefore, for this specific case Matriks provides more accurate data. On the other hand, there are some cases both of the databases cannot provide full information. To illustrate; for ADANA the first trading date is stated as February 21, 1991 where the data starts with August 16, 1994 at Matriks and October 12, 1995 at Datastream. In this case, none of the databases can distribute clear data.

To handle these types of problems, the most accurate solution could be to use a consistent dataset provided by the Borsa Istanbul. Nevertheless, due to the lack of data on that side only Datastream and Matriks datasets are compared in this thesis.

All tables used for the analysis are computed also with the Matriks data where the bold and underlined values are calculated based on Matriks database. Estimation and event windows are defines as (-244,-6) and (-5,+5), respectively, as before. Due to the inclusion of only survived companies, the number of securities now decreases (Table 47 and 48). Besides, the number of zero returns also declines since these are currently actively traded companies referring that the previously traded stocks from the earlier years of trading with higher number of zero returns are eliminated in this sample.

Table 47. Size of the Sample with Logarithmic Returns, Matriks Database

	Number of securities	Number of returns	Number of zero returns	Proportion of zero returns
Raw Data				
	471 **396**	1,475,196 **1,197,051**	527,546 **387,675**	35.76% **32.38%**
Clean sample				
	388 **307**	1,381,797 **1,072,417**	491,540 **347,294**	35.57% **32.38%**

Note: The values calculated based on Matriks database are given in bold & underlined at the second line.

Table 48. Size of the Sample with Arithmetic Returns, Matriks Database

	Number of securities	Number of returns	Number of zero returns	Proportion of zero returns
Raw Data				
	471 **396**	1,475,196 **1,197,051**	527,546 **387,675**	35.76% **32.38%**
Clean sample				
	388 **307**	1,381,822 **1,072,420**	491,540 **347,294**	35.57% **32.38%**

Note: The values calculated based on Matriks database are given in bold & underlined at the second line.

For both log and arithmetic returns; the mean is a little bit larger than the case for Datastream (Table 49 and 50) except for the market adjusted arithmetic returns. However, the difference is negligible. The standard deviation is nearly same (around 0.05) for logarithmic returns whereas the standard deviation is a little bit larger than the Datastream (around 1). Considering the raw data gathered from Datastream and Matriks, both skewness and kurtosis rise (implying higher asymmetry around the mean toward the positive values, and more peaked distribution) whereas the clean sample with Datastream has lower skewness and kurtosis. The reason of this change can be more positive and peaked returns are experienced with still existing firms compared to the sample including dead firms. The results for 1999-2012 in the Datastream (in Table 40 and 41) may also support the non-normality of returns over the latest decade since with the Matriks database only the survived companies would be listed.

Table 49. Descriptive Statistics for Logarithmic Returns in Matriks Database

Performance Measure	Mean	Standard deviation	Skewness	Kurtosis	Jarque-Bera Test
Logarithmic Returns of Raw Data	0.00092	0.05306	0.819	1,484.236	$109x10^9$
Logarithmic Returns of Clean Sample	0.00092	0.05047	0.519	56.727	$143x10^6$
Mean Adjusted Returns	0.00000	0.05306	0.803	1,484.528	$98x10^9$
Market Adjusted Returns	-0.00015	0.05444	0.70	1,352.758	$81x10^9$
Simple Market Model Returns	0.00000	0.05126	0.926	1,695.230	$128x10^9$

Table 50. Descriptive Statistics for Arithmetic Returns in Matriks Database

Performance Measure	Mean	Standard deviation	Skewness	Kurtosis	Jarque-Bera Test
Arithmetic Returns of Raw Data	0.00491	1.69597	642.607	417,932.091	$8{,}711\text{x}10^{12}$
Arithmetic Returns of Clean Sample	0.00222	0.05374	6.766	300.592	$4\text{x}10^{9}$
Mean Adjusted Returns	0.00000	1.69499	641.541	417,028.939	$7{,}771\text{x}10^{12}$
Market Adjusted Returns	0.00350	1.69603	642.558	417,888.677	$7{,}803\text{x}10^{12}$
Simple Market Model Returns	0.00000	1.69486	641.519	417,014.290	$7{,}770\text{x}10^{12}$

Comparing the test results (for log and arithmetic returns), there is no benefit of using the Matriks database from the point of specification error (Table 51, 52, 53 and 54 for logarithmic returns and Table 55, 56, 57 and 58 for arithmetic returns). However, with the Matriks data the power of tests slightly increases in most of the cases.

Similar to results for the Datastream (and also like BW) with log returns, the results indicate that the mean adjusted returns do not cause a significant specification and power problem (Table 51, 52, 53 and 54). Considering for all 4 tests, especially for crude dependence test and generalized rank test the difference in the specification error is only around

2-4 per cent. Also, (similarly) crude dependence test and generalized rank tests are well specified compared to other tests. Indeed, higher specification errors of other tests advice not to use other tests. A comparison between non-parametric and parametric tests on their performances cannot be made since both crude dependence and generalized rank tests indicate similar specification errors. On the other hand, the most powerful tests are Patell Z and generalized sign tests (Table 53 and 54).

With arithmetic returns, since under some methods for some tests there are some changes in both directions in specification error and power, we cannot generalize the results, and hence (as in the case of the Datastream) it cannot be stated that the tests for log results are more powerful than with those for arithmetic returns or specified better (Table 55, 56, 57 and 58).

The results with Matriks also confirm that the results from Turkish stock market favor both a parametric test (despite the non-normality of returns), the crude dependence test, and a non-parametric test, generalized rank test in contrary to the Asia-Pacific markets where the non-parametric tests outperform the parametric tests documented by Corrado and Truong (2008). It is important to note that compared to Datastream results, now with the Matriks database the difference in the specification error between CDA and generalized rank test is higher. This finding is similar to the results over 1999-2012 (in the Datastream database) that can be explained with an increase in the return variance over the recent time period (Cowan, 1992). With the Datastream, it is found that market model seems to fit the Turkish stock market data better than other methods did, but with Matriks database for log returns both market adjusted and market model returns seem to fit the Turkish stock market data. Especially with arithmetic returns, if Patell Z test is used, market adjusted returns method yields a lower specification error. In fact, this finding strengthens the results of BW; under certain circumstances the mean adjusted returns do not cause a significant specification and power problem.

Table 51. Comparison of Procedures with the Crude Dependence Adjustment Test for Log Returns in Matriks Database

Method	**Event Window (-5,+5)**	
	0	**5%**
Mean adjusted returns	10% **7%**	68% **72%**
Market adjusted returns	8% **6%**	66% **70%**
Market Model	6% **7%**	71% **74%**

Note: Comparison of different procedures for detecting abnormal performance: Percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; one-tailed test; significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 52. Comparison of Procedures with the Patell Z-Statistics for Log Returns in Matriks Database

Method	Event Window (-5,+5)	
	0	5%
Mean adjusted returns	19% **<u>17%</u>**	88% **<u>92%</u>**
Market adjusted returns	16% **<u>13%</u>**	95% **<u>95%</u>**
Market Model	12% **<u>19%</u>**	96% **<u>96%</u>**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 53. Comparison of Procedures with the Generalized Sign Test for Log Returns in Matriks Database

Method	Event Window (-5,+5)	
	0	5%
Mean adjusted returns	20% **<u>21%</u>**	96% **<u>100%</u>**
Market adjusted returns	12% **<u>12%</u>**	99% **<u>95%</u>**
Market Model	13% **<u>12%</u>**	98% **<u>98%</u>**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 54. Comparison of Procedures with the Generalized Rank Test for Log Returns in Matriks Database

Method	Event Window (-5,+5)	
	0	5%
Mean adjusted returns	10% **10%**	73% **72%**
Market adjusted returns	8% **10%**	76% **68%**
Market Model	6% **12%**	75% **73%**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 55. Comparison of Procedures with the Crude Dependence Adjustment Test for Arithmetic Returns in Matriks Database

Method	Event Window (-5,+5)	
	0	5%
Mean adjusted returns	11% **6%**	62% **64%**
Market adjusted returns	7% **8%**	72% **79%**
Market Model	6% **7%**	63% **63%**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0% Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 56. Comparison of Procedures with the Patell Z-Statistics for Arithmetic Returns in Matriks Database

Method	Event Window (-5,+5)	
	0	5%
Mean adjusted returns	18% **16%**	88% **94%**
Market adjusted returns	13% **14%**	98% **96%**
Market Model	13% **20%**	96% **95%**

Note: Comparison of different procedures for detecting abnormal performance of the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 57. Comparison of Procedures with the Generalized Sign Test for Arithmetic Returns in Matriks Database

Method	Event Window (-5,+5)	
	0	5%
Mean adjusted returns	24% **29%**	98% **100%**
Market adjusted returns	16% **13%**	99% **96%**
Market Model	11% **14%**	98% **99%**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 58. Comparison of Procedures with the Generalized Rank Test for Arithmetic Returns in Matriks Database

Method	**Event Window (-5,+5)**	
	0	**5%**
Mean adjusted returns	10% **10%**	73% **72%**
Market adjusted returns	7% **10%**	76% **68%**
Market Model	6% **12%**	74% **73%**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

6.5.1 Test Results for Sample Size Sensitivity with Matriks Database

In Table 59, 60, 61 and 62, the results for the Datastream can also be stated with the Matriks database (i.e., like BW, there is no significant change in the specification error, but power of tests decreases with samples of 20 securities). Especially with the crude dependence adjustment and generalized rank tests, the change in power is dramatic (Table 59 and 62). Similarly, for all tests the power of tests decreases whenever the sample size is smaller (i.e., strictly increasing function).

In general, (as found for the Datastream) the samples of 50 securities should be preferred over samples of 20 securities. As designing random samples at least samples composed of 50 securities should be chosen.

Table 59. Comparison of Procedures with the Crude Dependence Adjustment Test for Log Returns and Different Sample Sizes in Matriks Database

Method	Sample Size	Actual Level of Abnormal Performance at day "0" over Event Window (-5,+5)	
		0	5%
Mean adjusted returns	**Sample of 50 securities**	10% **7%**	68% **72%**
	Sample of 20 securities	4% **9%**	36% **39%**
Market adjusted returns	**Sample of 50 securities**	8% **6%**	66% **70%**
	Sample of 20 securities	4% **6%**	40% **35%**
Market Model	**Sample of 50 securities**	6% **7%**	71% **74%**
	Sample of 20 securities	4% **5%**	41% **38%**

Note: Comparison of different procedures for detecting abnormal performance for different sample sizes with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 60. Comparison of Procedures with the Patell Z-Statistics for Log Returns and Different Sample Sizes in Matriks Database

Method	Sample Size	Actual Level of Abnormal Performance at day "0" over Event Window (-5+5)	
		0	**5%**
Mean adjusted returns	**Sample of 50 securities**	19% **17%**	88% **92%**
	Sample of 20 securities	12% **13%**	62% **61%**
Market adjusted returns	**Sample of 50 securities**	16% **13%**	95% **95%**
	Sample of 20 securities	10% **11%**	70% **64%**
Market Model	**Sample of 50 securities**	12% **19%**	96% **96%**
	Sample of 20 securities	8% **11%**	74% **69%**

Note: Comparison of different procedures for detecting abnormal performance for different sample sizes with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 61. Comparison of Procedures with the Generalized Sign Test for Log Returns and Different Sample Sizes in Matriks Database

Method	Sample Size	Actual Level of Abnormal Performance at day "0" over Event Window (-5,+5)	
		0	5%
Mean adjusted returns	**Sample of 50 securities**	20% **21%**	96% **100%**
	Sample of 20 securities	10% **13%**	78% **77%**
Market adjusted returns	**Sample of 50 securities**	12% **12%**	99% **95%**
	Sample of 20 securities	13% **8%**	79% **61%**
Market Model	**Sample of 50 securities**	13% **12%**	98% **98%**
	Sample of 20 securities	12% **15%**	83% **78%**

Note: Comparison of different procedures for detecting abnormal performance for different sample sizes with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 62. Comparison of Procedures with the Generalized Rank Test for Log Returns and Different Sample Sizes in Matriks Database

Method	Sample Size	Actual Level of Abnormal Performance at day "0" over Event Window (-5,+5)	
		0	5%
Mean adjusted returns	**Sample of 50 securities**	10% **<u>10%</u>**	73% **<u>72%</u>**
	Sample of 20 securities	10% **<u>12%</u>**	41% **<u>38%</u>**
Market adjusted returns	**Sample of 50 securities**	8% **<u>10%</u>**	76% **<u>68%</u>**
	Sample of 20 securities	7% **<u>6%</u>**	46% **<u>40%</u>**
Market Model	**Sample of 50 securities**	6% **<u>12%</u>**	75% **<u>73%</u>**
	Sample of 20 securities	9% **<u>8%</u>**	47% **<u>40%</u>**

Note: Comparison of different procedures for detecting abnormal performance for different sample sizes with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

6.5.2 Test Results for Event Period Sensitivity for Matriks Database

As analyzed with the Datastream, an event window of (-5,+5) is compared with a shorter event window of (-1,+1) for Matriks database. Similar results can also be stated with the Matriks database for log returns in Table 63-66, and for arithmetic returns in Table 67-70; relatively well-specified tests are still the crude dependence and generalized rank tests, but now the change in the power of tests is not so dramatic as the event window shortens whereas still there is not a big change in specification error.

Table 63. Comparison of Procedures with the Crude Dependence Adjustment Test for Log Returns and Different Event Windows in Matriks Database

Method	**Days in event period**	**Actual Level of Abnormal Performance at day "0"over Event Window**	
		0	**5%**
Mean adjusted returns	**11 (-5,+5)**	10% **7%**	68% **72%**
	3 (-1,+1)	10% **8%**	98% **99%**
Market adjusted returns	**11 (-5,+5)**	8% **6%**	66% **70%**
	3 (-1,+1)	8% **6%**	99% **99%**
Market Model	**11 (-5,+5)**	6% **7%**	71% **74%**
	3 (-1,+1)	10% **9%**	99% **100%**

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 64. Comparison of Procedures with the Patell Z-Statistics for Log Returns and Different Event Windows in Matriks Database

Method	Days in event period	Actual Level of Abnormal Performance at day "0" over Event Window	
		0	5%
Mean adjusted returns	**11 (-5,+5)**	19% **17%**	88% **92%**
	3 (-1,+1)	19% **16%**	100% **100%**
Market adjusted returns	**11 (-5,+5)**	15% **13%**	95% **95%**
	3 (-1,+1)	16% **13%**	100% **100%**
Market Model	**11 (-5,+5)**	12% **19%**	96% **96%**
	3 (-1,+1)	12% **14%**	100% **100%**

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 65. Comparison of Procedures with the Generalized Sign Test for Log Returns and Different Event Windows in Matriks Database

Method	Days in event period	Actual Level of Abnormal Performance at day "0"over Event Window	
		0	**5%**
Mean adjusted returns	**11 (-5,+5)**	20% **21%**	96% **100%**
	3 (-1,+1)	16% **12%**	100% **100%**
Market adjusted returns	**11 (-5,+5)**	12% **12%**	99% **95%**
	3 (-1,+1)	14% **14%**	100% **100%**
Market Model	**11 (-5,+5)**	13% **12%**	98% **98%**
	3 (-1,+1)	11% **14%**	100% **100%**

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 66. Comparison of Procedures with the Generalized Rank Test for Log Returns and Different Event Windows in Matriks Database

Method	Days in event period	Actual Level of Abnormal Performance at day "0" over Event Window	
		0	**5%**
Mean adjusted returns	**11 (-5,+5)**	10% **10%**	73% **72%**
	3 (-1,+1)	10% **12%**	100% **100%**
Market adjusted returns	**11 (-5,+5)**	8% **10%**	76% **68%**
	3 (-1,+1)	8% **11%**	100% **100%**
Market Model	**11 (-5,+5)**	6% **12%**	75% **73%**
	3 (-1,+1)	8% **12%**	100% **100%**

Note: Comparison of different procedures for detecting abnormal performance for different event windows: Percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 67. Comparison of Procedures with the Crude Dependence Adjustment Test for Arithmetic Returns and Different Event Windows in Matriks Database

Method	Days in event period	Actual Level of Abnormal Performance at day "0" over Event Window	
		0	5%
Mean adjusted returns	**11 (-5,+5)**	11% **6%**	62% **64%**
	3 (-1,+1)	11% **8%**	98% **98%**
Market adjusted returns	**11 (-5,+5)**	7% **8%**	72% **79%**
	3 (-1,+1)	11% **6%**	99% **99%**
Market Model	**11 (-5,+5)**	6% **7%**	63% **63%**
	3 (-1,+1)	10% **8%**	99% **99%**

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 68. Comparison of Procedures with the Patell Z-Statistics for Arithmetic Returns and Different Event Windows in Matriks Database

Method	Days in event period	Actual Level of Abnormal Performance at day "0" over Event Window	
		0	**5%**
Mean adjusted returns	**11 (-5,+5)**	18% **16%**	88% **94%**
	3 (-1,+1)	16% **17%**	100% **100%**
Market adjusted returns	**11 (-5,+5)**	13% **14%**	98% **96%**
	3 (-1,+1)	15% **14%**	100% **100%**
Market Model	**11 (-5,+5)**	13% **20%**	96% **95%**
	3 (-1,+1)	15% **15%**	100% **100%**

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 69. Comparison of Procedures with the Generalized Sign Test for Arithmetic Returns and Different Event Windows in Matriks Database

Method	Days in event period	Actual Level of Abnormal Performance at day "0" over Event Window	
		0	5%
Mean adjusted returns	**11 (-5,+5)**	24% **29%**	98% **100%**
	3 (-1,+1)	20% **20%**	100% **100%**
Market adjusted returns	**11 (-5,+5)**	16% **13%**	99% **96%**
	3 (-1,+1)	13% **13%**	100% **100%**
Market Model	**11 (-5,+5)**	11% **14%**	98% **99%**
	3 (-1,+1)	10% **13%**	100% **100%**

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 70. Comparison of Procedures with the Generalized Rank Test for Arithmetic Returns and Different Event Windows in Matriks Database

Method	Days in event period	Actual Level of Abnormal Performance at day "0" over Event Window	
		0	5%
Mean adjusted returns	**11 (-5,+5)**	10% **10%**	73% **72%**
	3 (-1,+1)	10% **12%**	100% **100%**
Market adjusted returns	**11 (-5,+5)**	7% **10%**	76% **68%**
	3 (-1,+1)	9% **11%**	100% **100%**
Market Model	**11 (-5,+5)**	6% **12%**	74% **73%**
	3 (-1,+1)	9% **12%**	100% **100%**

Note: Comparison of different procedures for detecting abnormal performance for different event windows with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; arithmetic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

6.5.3 Test Results for Clustering with Matriks Database

Similar to the results for the Datastream, (for both logarithmic and arithmetic returns) under clustering problem both the specification error dramatically rises and the power of tests significantly decreases (Table 71-74 for logarithmic returns and Table 75-78 for arithmetic returns). Compared to Datastream, the gain from the use of non-clustering can be more in the Matriks database.

The finding for the Datastream in the Turkish stock market is also supported with the Matriks database: there is a significant deterioration in specification error whenever mean adjusted returns are used. Especially with the generalized rank test, there is a significant difference in the specification error between with mean adjusted returns and other two methods. Therefore, again clustering significantly alters the results, and hence clustering is a severe problem that should be separately handled. Mean adjusted returns cannot perform well under clustering problem; so that market model or market adjusted returns should be used for the Turkish stock market data in the Matriks database.

Table 71. Comparison of Procedures with/out Clustering with the Crude Dependence Adjustment Test for Log Returns in Matriks Database

Method		**Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)**	
		0	**5%**
Mean adjusted returns	**Non-Clustering**	10% **<u>7%</u>**	68% **<u>72%</u>**
	Clustering	15% **<u>17%</u>**	26% **<u>28%</u>**
Market adjusted returns	**Non-Clustering**	8% **<u>6%</u>**	66% **<u>70%</u>**
	Clustering	7% **<u>7%</u>**	28% **<u>19%</u>**
Market Model	**Non-Clustering**	6% **<u>7%</u>**	71% **<u>74%</u>**
	Clustering	9% **<u>12%</u>**	38% **<u>30%</u>**

Note: Comparison of different procedures for detecting abnormal performance with/out clustering with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 72. Comparison of Procedures with/out Clustering with the Patell Z-Statistics for Log Returns in Matriks Database

Method		**Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)**	
		0	**5%**
Mean adjusted returns	**Non-Clustering**	19% **17%**	88% **92%**
	Clustering	66% **50%**	77% **69%**
Market adjusted returns	**Non-Clustering**	16% **13%**	95% **95%**
	Clustering	37% **50%**	70% **67%**
Market Model	**Non-Clustering**	12% **19%**	96% **96%**
	Clustering	40% **47%**	77% **69%**

Note: Comparison of different procedures for detecting abnormal performance with/out clustering with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 73. Comparison of Procedures with/out Clustering with the Generalized Sign Test for Log Returns in Matriks Database

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	5%
Mean adjusted returns	Non-Clustering	20% **<u>21%</u>**	96% **<u>100%</u>**
	Clustering	75% **<u>60%</u>**	87% **<u>86%</u>**
Market adjusted returns	Non-Clustering	12% **<u>12%</u>**	99% **<u>95%</u>**
	Clustering	57% **<u>75%</u>**	84% **<u>82%</u>**
Market Model	Non-Clustering	13% **<u>12%</u>**	98% **<u>98%</u>**
	Clustering	46% **<u>61%</u>**	88% **<u>84%</u>**

Note: Comparison of different procedures for detecting abnormal performance with/out clustering with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 74. Comparison of Procedures with/out Clustering with the Generalized Rank Test for Log Returns in Matriks Database

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	**5%**
Mean adjusted returns	**Non-Clustering**	10% **<u>10%</u>**	73% **<u>72%</u>**
	Clustering	19% **<u>26%</u>**	30% **<u>36%</u>**
Market adjusted returns	**Non-Clustering**	8% **<u>10%</u>**	76% **<u>68%</u>**
	Clustering	10% **<u>10%</u>**	23% **<u>15%</u>**
Market Model	**Non-Clustering**	6% **<u>12%</u>**	75% **<u>73%</u>**
	Clustering	13% **<u>13%</u>**	28% **<u>28%</u>**

Note: Comparison of different procedures for detecting abnormal performance with/out clustering with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; logarithmic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 75. Comparison of Procedures with/out Clustering with the Crude Dependence Adjustment Test for Arithmetic Returns in Matriks Database

Method		**Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)**	
		0	**5%**
Mean adjusted returns	**Non-Clustering**	11% **6%**	62% **64%**
	Clustering	16% **17%**	26% **28%**
Market adjusted returns	**Non-Clustering**	7% **8%**	72% **79%**
	Clustering	9% **8%**	41% **21%**
Market Model	**Non-Clustering**	6% **7%**	63% **63%**
	Clustering	10% **11%**	36% **28%**

Note: Comparison of different procedures for detecting abnormal performance with/out clustering with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; arithmetic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 76. Comparison of Procedures with/out Clustering with the Patell Z-Statistics for Arithmetic Returns in Matriks Database

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	5%
Mean adjusted returns	Non-Clustering	18% **<u>16%</u>**	88% **<u>94%</u>**
	Clustering	68% **<u>52%</u>**	73% **<u>64%</u>**
Market adjusted returns	Non-Clustering	13% **<u>14%</u>**	98% **<u>96%</u>**
	Clustering	40% **<u>52%</u>**	80% **<u>73%</u>**
Market Model	Non-Clustering	13% **<u>20%</u>**	96% **<u>95%</u>**
	Clustering	39% **<u>48%</u>**	78% **<u>67%</u>**

Note: Comparison of different procedures for detecting abnormal performance with/out clustering with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; arithmetic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 77. Comparison of Procedures with/out Clustering with the Generalized Sign Test for Arithmetic Returns in Matriks Database

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	**5%**
Mean adjusted returns	**Non-Clustering**	24% **29%**	98% **100%**
	Clustering	73% **66%**	89% **89%**
Market adjusted returns	**Non-Clustering**	16% **13%**	99% **96%**
	Clustering	55% **72%**	85% **82%**
Market Model	**Non-Clustering**	11% **14%**	98% **99%**
	Clustering	44% **57%**	86% **83%**

Note: Comparison of different procedures for detecting abnormal performance with/out clustering with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; arithmetic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

Table 78. Comparison of Procedures with/out Clustering with the Generalized Rank Test for Arithmetic Returns in Matriks Database

Method		Actual Level of Abnormal Performance at day "0" for the event window (-5,+5)	
		0	**5%**
Mean adjusted returns	**Non-Clustering**	10% **10%**	73% **72%**
	Clustering	18% **26%**	30% **36%**
Market adjusted returns	**Non-Clustering**	7% **10%**	76% **68%**
	Clustering	10% **10%**	23% **15%**
Market Model	**Non-Clustering**	6% **12%**	74% **73%**
	Clustering	14% **15%**	28% **29%**

Note: Comparison of different procedures for detecting abnormal performance with/out clustering with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; event window (-5, +5); significance level 5%; randomly selected securities and event dates; arithmetic returns; Matriks Database results are given in bold & underlined at the second line where the first line denotes the results for the Datastream over 1988-2012.

6.6 Comparison of the Excel & Stata Codes with the Datastream

In order to calculate the test statistics, both an Excel file running via macros and Stata file is used. Even though same calculation logic and sample design is used for both codes (macros in Excel & Stata codes), there appears to be minor differences in specification errors and power of tests. Since the randomization (among and within samples) takes place, the test statistics of Excel and Stata are not the same explaining the difference in test results.

Concentrating on the Stata results, all 4 test results for both log and arithmetic returns are also valid for Stata codes (Table 79, 80, 81 and 82). Similar to other results: crude dependence and generalized rank tests (especially the crude dependence test) are well specified compared to other tests. The most powerful tests are Patell Z and generalized sign tests. Similarly, a general performance comparison of log and arithmetic returns cannot be made since there is not a generalization for all cases. In general, the results obtained via macros can be accepted since there is not a dramatic change as using the Stata codes. Therefore, like BW, the mean adjusted returns do not cause a significant specification and power problem.

Table 79. Comparison of Procedures with the Crude Dependence Adjustment Test in Stata

Method		Actual Level of Abnormal Performance at day "0" over Event Window (-5,+5)	
		0 **Results for Log/Arithmetic Returns**	**5%** **Results for Log/Arithmetic Returns**
Mean adjusted returns	*Excel* *Stata*	10% / 11% **6% / 6%**	68% / 62% **72% / 65%**
Market adjusted returns	*Excel* *Stata*	8% / 7% **10% / 3%**	66% / 72% **74% / 79%**
Market Model	*Excel* *Stata*	6% / 6% **7% / 5%**	71% / 63% **81% / 69%**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; one-tailed test; significance level 5%; randomly selected securities and event dates; logarithmic returns/arithmetic returns; Stata Codes Results in bold & underlined in the second line whereas the first line shows the Excel code results.

Table 80. Comparison of Procedures with the Patell Z-Statistics in Stata

Method		**Actual Level of Abnormal Performance at day "0" over Event Window (-5,+5)**	
		0 **Results for Log/Arithmetic Returns**	**5%** **Results for Log/Arithmetic Returns**
Mean adjusted returns	*Excel*	19% / 18%	88% / 88%
	Stata	**15% / 14%**	**91% / 90%**
Market adjusted returns	*Excel*	16% / 13%	95% / 98%
	Stata	**16% / 9%**	**96% / 98%**
Market Model	*Excel*	12% / 13%	96% / 96%
	Stata	**11% / 13%**	**99% / 99%**

Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns/arithmetic returns; Stata Codes Results in bold & underlined in the second line whereas the first line shows the Excel code results.

Table 81. Comparison of Procedures with the Generalized Sign Test in Stata

Method		Actual Level of Abnormal Performance at day "0" over Event Window (-5,+5)	
		0 **Results for Log/Arithmetic Returns**	**5%** **Results for Log/Arithmetic Returns**
Mean adjusted returns	*Excel* *Stata*	20% / 24% **11% / 18%**	96% / 98% **96% / 97%**
Market adjusted returns	*Excel* *Stata*	12% / 16% **12% / 12%**	99% / 99% **99% / 99%**
Market Model	*Excel* *Stata*	13% / 11% **11% / 14%**	98% / 98% **100% / 99%**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns/arithmetic returns; Stata Codes Results in bold & underlined in the second line whereas the first line shows the Excel code results.

Table 82. Comparison of Procedures with the Generalized Rank Test in Stata

Method		Actual Level of Abnormal Performance at day "0" over Event Window (-5,+5)	
		0 **Results for Log/Arithmetic Returns**	**5%** **Results for Log/Arithmetic Returns**
Mean adjusted returns	*Excel* *Stata*	10% / 10% **12% / 6%**	73% / 73% **74% / 71%**
Market adjusted returns	*Excel* *Stata*	8% / 7% **8% / 4%**	76% / 76% **78% / 79%**
Market Model	*Excel* *Stata*	6% / 6% **10% / 6%**	75% / 74% **76% / 81%**

Note: Comparison of different procedures for detecting abnormal performance with the percentage of 250 samples where the null hypothesis is rejected. H_0: cumulative abnormal performance over event window = 0%. Sample size=50; significance level 5%; randomly selected securities and event dates; logarithmic returns/arithmetic returns; Stata Codes Results in bold & underlined in the second line whereas the first line shows the Excel code results.

6.7 Other Important Parameters

6.7.1 Impact of Crisis

Since this thesis focuses on the comparison of different methodologies for the Borsa Istanbul, the impact of crisis is not considered here. Even though it is known that some event dates may fall around crisis dates, the design is pure randomization meaning that event dates for all firms throughout samples would differ and change randomly. Considering such a design, the impact of crisis is not analyzed as a separate case. However, in order to visualize how the random event dates may be distributed around crisis years; the frequency distribution of random event dates is illustrated in Figure 4. Due to the lack of data over the early trading years of the Exchange, the frequency of event dates has a tendency to be centered after 2000's, but there is no specific outlier around crisis years that may mislead the computations.

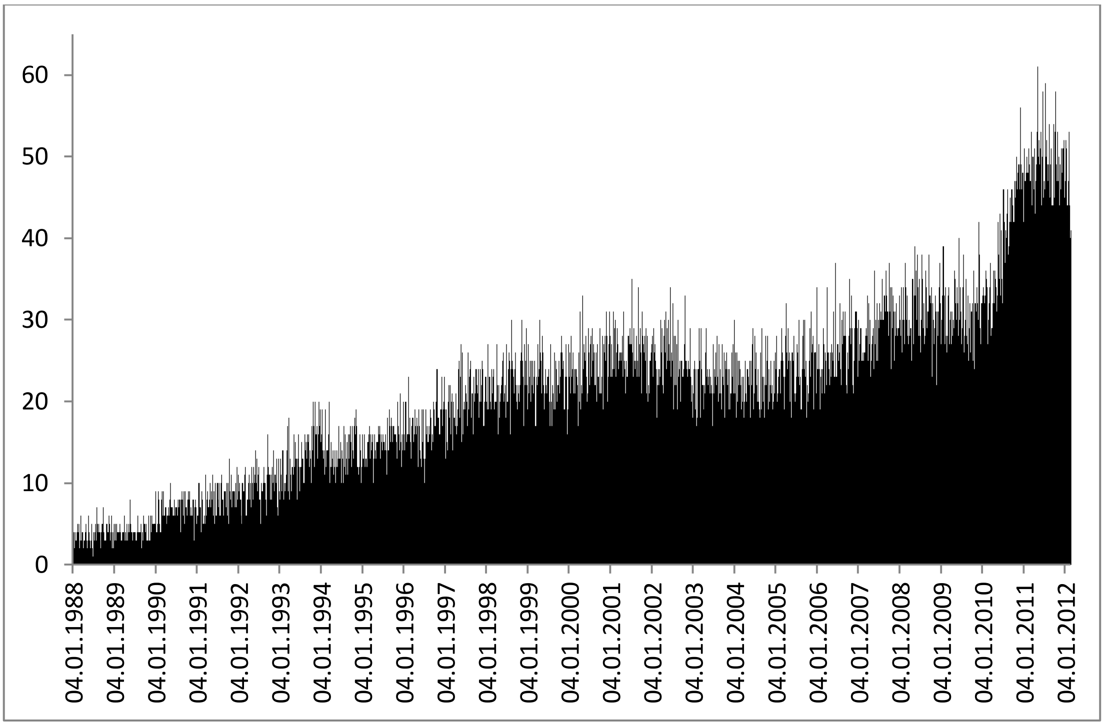

Figure 4. The Frequency Distribution of Random Event Dates

6.7.2 Impact of Price Limit

In November 1987, with the launch of the multiple price continuous auction system, 10 per cent price margin regulation has also been adopted[49]

[49] The lowest and the highest prices which may be offered for an equity within the session constitute the "Price Margin/Price Range" of that equity. The price margin is automatically calculated by the System to be 10% above and below the base price in every session. The upper limit is determined by rounding to the appropriate upper price tick whereas the lower limit is determined by rounding to the lower price tick. In the rights issue coupon market, the price margin is 25%. "Base Price" is the price which constitutes a base for determining the upper and the lower price limits of an equity between which equity can be traded during a session. The "Base Price" is calculated by rounding the "Weighted Average Price" of the previous session to the nearest price tick. "Price Tick" is the least price variation that may occur once at a time for each equity.

(Gülay, 2007). Prior to this regulation the price margin was applied as 5 per cent. Since the time period considered in this thesis covers 1988-2012, the price margin is always set at 10 percent. Considering the price limits, some of the criteria applied to have a clean sample should be redundant (such as outliers greater than 1000%), but these criteria are applied in order to get rid of the erroneous entries. Besides, the cases with/out price limits could not be compared due to the unchanged regulation.

In addition to the price limits, ISE Inspection and Surveillance Board prepared an Action Plan for Efficient Surveillance in the beginning of 2010, and "ISE Automatic Circuit Breaker System" has been introduced as an integral part of the said Action Plan. The mechanism is called ISE Automated Circuit Breaker System, and adopted by the CMB; it is an integral part of the new trading measures introduced for the Equity Market dated July 23, 2010. ISE Automatic Circuit Breaker System came into force on January 10, 2011.

Borsa Istanbul Regulation Article 25 paragraph (b) envisages that trading of an equity may be suspended in the event that orders of an abnormal price or quantity are sent to the Equity Market trading system, or that the occurrence of some other elements inhibit the formation of a healthy market. By the same token, according to the provisions of the Settlement and Custody Centers Regulation, Borsa Istanbul is authorized to change the settlement method of securities.

Considering the distribution of event dates, only 12,795 random event dates fall after 2010 implying that 11.6 per cent of event dates fall within the Circuit Breaker System. The suspension period is parametrical, and is initially defined as 15 minutes for the stocks traded with continuous auction trading method, or for the rest of the session, if there is less than fifteen minutes to the end of the session. In the case of stocks traded with single price method, suspension will be applied for the whole session. Therefore, considering the length of the suspension but use of daily returns here, and also the percentage of random event dates falling within the system, the impact of the system is not considered as a separate case here. In the future, an extended study focusing the impact of this regulation on stock prices can be conducted as a separate case.

6.7.3 Daily Volatility Increases

Even though in Chapter 5 general statistics related to the whole dataset are presented, statistics by stocks are ignored. Only, pre-defined criteria are applied in order to have a sufficient and reliable dataset. In addition to these, volatility of each stock is considered to quantify this effect. In Table 83, the most volatile stocks are listed. Since the highest standard deviation is tolerable (13.6%), daily volatility increases are not considered as a separate case.

Table 83. The Most Volatile Stocks in the Datastream Dataset

Stock	Standard Deviation
EMSAN PASLANMAZ	13.6%
DEMIRBANK	9.3%
TKI.SINAI KALK.BKSI.	8.6%
T IS BANK (C-%75BDL)	8.4%
YUNSA YUNLU SAN VE TC.	8.4%
IHLAS MADENCILIK	8.0%
BSH EV ALETLERI SAN VE TC.	7.9%
GORBON ISIL SERAMIK	7.8%
PETUN ET VE UN	7.5%
EGE GUBRE SANAYI	7.5%

Also, in Corrado (2011) cross-sectional variance adjustments are found to be impractical in event studies with a small sample size and may be even difficult with medium-sized samples. Hilliard and Savickas (2002) indicate that even using advanced techniques estimating and making inferences regarding the event-induced volatilities may be unreliable. For a robust test with the higher event date abnormal return variances, Corrado (2011) suggests to use the rank test. Even doubling the variance, Type I error rate for the t-test becomes 12.2 percent, but 8.2 per cent for the rank test (Table 84). Therefore, a detailed analysis of increase in variance around the randomized event dates are not considered here, but rather both parametric and non-parametric tests are adopted at the same time.

Table 84. Comparison of Rank Test and t-Test Specification with Event-Induced Volatility

Event date abnormal return variance change (λ^2)*	Rank Test Level (%)	Misspecification in Rank Test	T-test Level (%)	Misspecification in Rank Test
1	5	0	5.0	0
2	8.2	3.2	12.2	7.2
4	10.8	5.8	20.5	15.5
8	12.7	7.7	28.0	23.0

(*) λ^2 denotes the variance of event-date standardized abnormal returns, and if λ=1, this means that test statistics are distributed as standard normal. On the other hand, λ^2 = 2 implies doubling the event date abnormal return variance.
Note: The degree of misspecification is measured by deviations of actual Type-I error rates from the nominal 5 per cent level.
Source: Corrado (2011) Event Studies: A Methodology Review, *Accounting and Finance*, 51, 207-234.

6.7.4 GLS Heteroscedastic Models

Even though this thesis is a first attempt to compare different methodologies, one of the basic limitations is to provide a limited number of performance measures. GLS heteroscedastic models or other more complex models are left out in order to prepare simple and user friendly programs for event studies. For future research the codes can be developed to cover more models and tests in the same file. Nevertheless, it should be noted that inclusion of even a single model or test would bring capacity or latency problems together.

6.7.5 Modified Codes for User-Defined Event Dates

As indicated in the Section 5, both an Excel file and Stata codes are used in order to compute the test statistics. Since this analysis is based on artificial event dates and randomization of firms as well as the event dates, macros and codes are designed for this purpose. Nevertheless, in order to verify the results of these codes user-defined versions of each file are also created. For the exactly same dataset and same event dates both codes turn out the same test results verifying the use of these files.

CHAPTER 7

CONCLUSIONS

The primary research question of this thesis is to try to determine the appropriate event study methodology for studies carried out on the Borsa Istanbul. Considering the wide area of usage, event studies are used to analyze the timing and persistence of any kind of political or economic event's impact since the results may give information about the structure of the market.

In order to find the most appropriate methodology for the Turkish stock market we compare the performance of different models (mean adjusted returns, market adjusted returns, and simple market model) with two parametric (portfolio time-series standard deviation test, Patell test) and two non-parametric tests (generalized sign and generalized rank tests) under different return definitions (log versus arithmetic returns), sample sizes, event windows, and clustering. Also, the sensitivity of results to time period, comparisons of different databases (Datastream versus Matriks) as well as different statistical tools (Excel macros versus Stata) are considered. This thesis basically follows the experimental design of BW but modifies the test statistics in line with the current developments.

This research contributes to the existing literature by extending the BW methodology in a developing market, actually first time comprehensively for the Turkish stock market. Besides, by giving an insight about the underlying model for Turkish stock market this thesis provides a guideline for future studies that would adopt event study methodology in order to investigate the impacts of various political or economic events on stock prices in Turkey. As seen in the previous studies for Turkey[50], even though there are articles investigating the impact of various events by using different samples, there is no reasoning in the selection of the performance model creating a gap in understanding the Turkish stock market. Except Gümüş (2008), 32 out of 71 event studies on Turkey employ market adjusted returns with explanations, but without grounding the reasoning on methodological computations. Indeed, the results of this thesis emphasize that without analyzing the best-fitting model, it would be misleading to conduct and interpret tests. Besides, the usage of non-parametric tests for Turkish stock markets is limited in contrary to highly non-normal features.

According to the results on Turkish stock market data of 471 securities over 1988-2012, the percentage of zero returns is around 35 per cent with high non-normality properties supporting the findings on non-normality of returns in Muradoğlu and Ünal (1994) and Campbell et al. (2009). Comparing with the study of Corrado and Truong (2008), proportion of zero returns (approx. 35-36%) is tolerable compared to Malaysia or Singapore, but higher than the US, Japan and Korea. The mean is nearly zero (below 1%) and standard deviation is around 5% similar to other countries.

[50] These studies are summarized in Section 2.2.

Comparing the results of arithmetic and logarithmic returns, there are some changes in both directions in specification error and power for tests implying that none of them dominates the other one.

Focusing the results of BW (arithmetic returns for crude dependence test), with Turkish data the specification error is a little bit larger and the power of tests is lower. After adding 2 per cent abnormal artificial return at time zero, the power of tests is still around 85 per cent whereas BW indicate nearly 100 per cent. In other words, in BW nearly with 100 per cent probability the CDA test is able to detect the abnormal return when there is actually is, but this probability goes down to around 85 per cent for Turkey. One possible explanation for this finding can be the difference between the US and Turkish markets, which necessitate applying further methods for Turkey that would result in lower specification error and higher power even though there is not a big gap between the results.

Whenever the sample size decreases from 50 securities to 20 securities, there is a slight decrease in the specification error. Similar to BW (and as expected[51]) there is no significant gain in the specification error, but the power of tests dramatically changes. For all tests the power of tests decreases whenever the sample size is smaller (i.e., strictly increasing function). Therefore, a researcher should prefer the samples of 50 securities over samples of 20 securities as conducting an event study for Turkish stock markets.

[51] Kothari and Warner (2006) indicate that as the sample size gets larger, so the power of tests.

Comparing different event windows ((-5,+5), (-1,+1) and one-day event window), there is not a big change in specification error, but power of tests increase significantly in all cases whenever the event window shortens, as found in BW. In this analysis, one point to be careful is that with the shorter event window, the event is still always in the window for certainty by the design.

Whenever the clustering problem is introduced by restricting the same event date for all securities in a given sample, both the specification error dramatically rises and the power of tests significantly decreases. Therefore, clustering significantly alters the results, and hence clustering is a severe problem that should be avoided in the Turkish stock market. Mean adjusted returns cannot perform well under clustering problem; so that this performance model should not be preferred for the Turkish stock market data. To illustrate; a researcher willing to investigate the impact of the inflation announcements on stock returns should use the market model or at least market adjusted returns to test the significance of abnormal returns.

As shortening the time period from 1988-2012 to 1999-2012, there is not a significant improvement in the specification error. Indeed, there is a dramatic deterioration for the generalized rank test. Also, there is an increase in the power of tests, as a result of the decrease in the standard deviations, except the generalized rank test. One of the explanations for this change in the generalized rank test can be an increase in the return variance over the recent time period (Cowan, 1992). Serra (2002) mentions that the parametric tests may perform even better than the rank test under return variance increases –specifically, whenever misspecification problem arises. Cowan and Sergeant (1996) also support the specification error of rank test under variance increases. In general over 1999-2012 the market model yields the lowest specification error and highest power for tests in the Turkish stock market.

With the replication of all tests with the Matriks Database, there is no benefit of using the Matriks database from the point of specification error. However, with the Matriks data the power of tests slightly increases in most of the cases. With Matriks database the differences between the three methods in the specification error lower compared to those with Datastream. In fact, this finding strengthens the results of BW; under certain circumstances the mean adjusted returns do not cause a significant specification and power problem. Lastly, the results with the Stata codes support the finding that the mean adjusted returns do not cause a significant and power problem.

All test results under different circumstances are summarized in Table 85 and 86. In Table 85, the comparison of parametric and non-parametric tests is done under different circumstances. It is apparent that the crude dependence adjustment test is preferred in most of the cases supporting the view that there can be return variance increases so that a parametric test performs better than parametric ones. Since both CDA and generalized rank test referred in the table, parametric and non-parametric tests can be applied together for Turkish stock market since one group of tests cannot outperform the other one to specify the right model. The findings for Borsa Istanbul do not support the finding of Corrado and Truong (2008) that claim that non-parametric tests, especially the generalized rank test, outperform the others.

For the Borsa Istanbul, both a non-parametric (namely, generalized rank test) and a parametric test (namely, crude dependence test) indicate similar specification errors even though the returns exhibit highly non-normal properties. One of the explanations for this finding (the parametric tests perform well as the rank test) can be an increase in the variance as suggested by Serra (2002) and Cowan and Sergeant (1996).

Table 85. Comparison of Tests in Different Cases

Different Cases	Well-specified Test(s)
Log and Arithmetic Returns	Crude Dependence Adjustment & Generalized Rank Tests
Smaller sample size (20 securities) with log and arithmetic returns	Crude Dependence Adjustment Test
Shorter event period (-1,+1) and one-day event window with log and arithmetic returns	Crude Dependence Adjustment & Generalized Rank Tests
Clustering with log and arithmetic returns	Crude Dependence Adjustment Test
1999-2012 time period with log and arithmetic returns	Crude Dependence Adjustment Test
Log and arithmetic returns in the Matriks database	Crude Dependence Adjustment Test
Smaller sample size (20 securities) in the Matriks database with log and arithmetic returns	Crude Dependence Adjustment Test
Shorter event period (-1,+1) in the Matriks database with log and arithmetic returns	Crude Dependence Adjustment Test
Clustering in the Matriks database with log and arithmetic returns	Crude Dependence Adjustment Test
Stata codes with log and arithmetic returns	Crude Dependence Adjustment Test

Also, in Table 86 all findings on method selection are summarized. Like BW, the results indicate that the mean adjusted returns do not cause a severe specification and power problem under certain circumstances, but in general market model[52] or at least market adjusted returns should be used (especially under clustering) not to have misleading test results.

Table 86. Comparison of Methods by Tests, based on Specification Error

Different Cases	CDA Test	Patell-Z	Generalized Sign Test	Generalized Rank Test
Log returns	Mean adjusted returns	Mean adjusted returns	Mean adjusted returns	Mean adjusted returns
Arithmetic Returns	Mean adjusted returns	Mean adjusted returns & Market adjusted returns	Mean adjusted returns	Mean adjusted returns
Smaller Sample Size (20 securities) with log and arithmetic returns	Market Model	Market Model	Market Model	Market adjusted returns
Shorter event period (-1,+1) and one-day event window with log and arithmetic returns	Market adjusted returns & Market Model	Market Model	Market Model	Market adjusted returns & Market Model

[52] It is important to note that market model also seems to fit the Turkish stock market data even though the returns demonstrate highly non-normal properties and the underlying assumptions of market model should be accepted in advance.

Table 86 (cont'd)

Clustering with log and arithmetic returns	Market adjusted returns	Market adjusted returns & Market Model	Market Model	Market adjusted returns
1999-2012 time period with log and arithmetic returns	Market Model	Market Model	Market Model	Market adjusted returns
Log and arithmetic returns in the Matriks database	All three methods are similar	Market adjusted returns	Market adjusted returns & Market Model	Market adjusted returns & Mean adjusted returns
Smaller sample size (20 securities) in the Matriks database with log and arithmetic returns	Market Model	Market Model	Market adjusted returns	Market adjusted returns
Shorter event period (-1,+1) in the Matriks database with log and arithmetic returns	Market adjusted returns	Market adjusted returns	Mean adjusted returns & Market Model	All three methods are similar
Clustering in the Matriks database with log and arithmetic returns	Market adjusted returns	Market Model	Market Model	Market adjusted returns

Table 86 (cont'd)

Stata codes with log and arithmetic returns	Mean adjusted and market adjusted returns	Market adjusted returns & Market Model	Market adjusted returns (for log returns all three methods are similar)	Market adjusted returns

Considering all results, apart from several details of all findings, the main useful interpretation is for the market participants: the best fitting or characterizing model search for Turkish stock market. The results suggest that using mean adjusted returns would not cause a severe problem as suggested by BW for the US. By using the CDA test and arithmetic mean adjusted returns, a researcher can detect an abnormal return of 1 per cent (when actually there is abnormal return) with 33 per cent probability in Turkish stock market. This probability goes up to 81 per cent in case of 2 per cent abnormal returns. Therefore, a researcher should know the nature of the event and possible impact on returns in advance of an event study for Turkey. It should be noticed that in case of events that can affect the returns with a slight change such as 0.5 per cent, the power of tests would be very low (around 15 per cent).

Besides, a researcher should be aware of the implications of clustering problem on the method selection. Clustering problem generally arises in case of the tests of macroeconomic variables' impact such as Central Bank or inflation announcements affecting the variables on the same date. The results of this thesis clearly proves that for these analyses in Turkish stock market the event study methodology should be applied cautiously, and the researcher should not prefer mean adjusted returns.

Another practical finding of this thesis is the comparison of databases. Especially for the practitioners using various databases should be cautious on the content. The results based on two different databases (Datastream and Matriks) show that the adjustments on prices by different databases could also affect the return calculation method used for best fitting model.

For further research, the comparison of different methods can be extended by inclusion of a generated equally weighted index, different complex models such as GLS heteroscedatic models and various parametric and non-parametric tests together. Especially, the comparison of databases (such as Datastream vs. Matriks) can be extended by decomposing exactly the same stocks rather than comparing the whole dataset collectively once. This initial attempt to understand Turkish Stock Markets can also be broadened to cover different countries or group of countries to search for commonalities.

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APPENDICES

APPENDIX A

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐
Sosyal Bilimler Enstitüsü ☒
Uygulamalı Matematik Enstitüsü ☐
Enformatik Enstitüsü ☐
Deniz Bilimleri Enstitüsü ☐

YAZARIN
Soyadı : BAŞDAŞ
Adı : ÜLKEM
Bölümü : İŞLETME BÖLÜMÜ

TEZİN ADI (İngilizce) : EVENT STUDY METHODOLOGY FOR THE BORSA ISTANBUL

TEZİN TÜRÜ : Yüksek Lisans ☐ Doktora ☒

1. Tezimin tamamı dünya çapında erişime açılsın ve kaynak gösterilmek şartıyla tezimin bir kısmı veya tamamının fotokopisi alınsın. ☒
2. Tezimin tamamı yalnızca Orta Doğu Teknik Üniversitesi kullanıcılarının erişimine açılsın. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☐
3. Tezim bir (1) yıl süreyle erişime kapalı olsun. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☐

TEZİN KÜTÜPHANEYE TESLİM TARİHİ:

Yazarın İmzası .... Tarih ....

APPENDIX B

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Basdas, Ulkem
Nationality: Turkish (TC)
Date and Place of Birth: 16 August 1982, Izmir
Phone: +90 542 60 33 63
E-mail: ulkemb@yahoo.com

EDUCATION

2004 – 2007 Bilkent University, Ankara/Turkey
M.A. in Economics (with full fellowship)
2000 – 2004 Middle East Technical University, Ankara/Turkey
B.S. in Economics (Minor in Industrial Engineering on Operational Research)
CGA: 3.61/4.00 (High Honor Student)
Ranked 13th out of 145 students
1997 – 2000 Izmir Science High School, Izmir/Turkey

ACADEMIC EXPERIENCE

November 2007 - June 2009 Middle East Technical University
Research Assistant
Lectures assisted: Managerial Skills Laboratory, Visual Basic Laboratory, Managerial Economics, Financial Derivatives
February 2007 - June 2007 Bilkent University
Student Assistant
Lecture assisted: Econ-302 Econometrics II
August 2004 - January 2005 Bilkent University
Student Assistant
Lecture assisted: Econ-101 Introduction to Economics
February 2003 - June 2004 Middle East Technical University
Student Assistant
Lecture assisted: International Trade I-II

WORK EXPERIENCE

2010 (current) Borsa Istanbul (Istanbul Exchange), Istanbul/Turkey
Assistant Expert/Marketing and Sales Department
2009 – 2010 Economic Policy Research Institute (EPRI), Ankara/Turkey
Economic Policy Analyst
2005 – 2009 Siemens Business Services Corp., Ankara/Turkey
Project Commercial Manager

OTHER SKILLS & PERSONAL

Languages: English (advanced), German (basic), Russian (basic), Spanish (basic)

Software Packages: Matlab, LINDO, LINGO, Minitab, Microfit, Stata, E-views, SPSS and SAP 4.6C Advance level user of FI-CO-MM modules

Hobbies: Latin dance, long-distance swimming, tennis, snowboard (METU and Bilkent Snowboard Team memberships), stage musicals (Performance: "And the women" 2009), Pilates (International Pilates Federation Matwork Certification, April 2013)

PUBLICATIONS

Publications appear in "Science Citation Index Expanded":

Basdas (2012) Interaction between MENA Stock Markets: A Comovement Wavelet Analysis, *Wulfenia Journal*, 19(8), 340-354.

Basdas (2012) Market Data Dissemination Policies: What is important?, *Wulfenia Journal*, 19(8), 105-113.

Other Publications:

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APPENDIX C

TURKISH SUMMARY

BORSA İSTANBUL'DA OLAY ÇALIŞMASI METODOLOJİSİ

Olay çalışması, genellikle ekonomik veya politik olayların zamanlamasını ve etki sürelerini analiz etmek için kullanılan bir metot olup piyasaların yapısı hakkında da bilgi vermesi sebebi ile geniş bir uygulama alanına sahiptir. Bu sebeple, olay çalışması metodolojisi ile şu ana kadar yapılan çalışma sayısı tam olarak bilinmemektedir (Corrado, 2011). Sadece 1974-2000 döneminde belli başlı finans dergilerinde yayınlanan ve olay çalışması metodolojisini kullanan 565 makale bulunmaktadır (Kothari and Warner, 2007). Finans alanında yapılan olay çalışmalarındaki temel amaç herhangi bir olayın menkul kıymet fiyatları üzerindeki beklenmeyen veya anormal etkisini sayısallaştırmaktır. Olay çalışmaları her ne kadar direkt olarak piyasa etkinliğini testleri olmasa da olayların zamanlaması ve etkinin süresi piyasa yapısı hakkında bilgi vermektedir. Diğer bir deyişle, olayın etkisinin kalıcılığı piyasa etkinliğinin bir testi olmaktadır. Fama (1970) yarı formda etkinlik için fiyat değişiminin büyüklüğü yerine fiyat düzeltmesinin hızının önemli olduğunu belirtmiştir.

Olay çalışması metodolojisinin önemini göz önüne alarak, bu tez Borsa İstanbul verileri kullanılarak yapılacak olay çalışmalarında kullanılması en uygun metodolojileri belirlemeyi amaçlamıştır. Bu amaçla, Türkiye Pay Piyasası'nda getiri hesaplamada kullanılan farklı modellerin performansları (ortalama ile düzeltilmiş, piyasa getirisi ile düzeltilmiş ve piyasa modeli) iki parametrik (portföy zaman serisi standart sapma testi ve Patell testi) ve iki parametrik olmayan test ile (genelleştirilmiş işaret ve genelleştirilmiş sıralama testi) farklı getiri tanımları (logaritmik ve aritmetik), örneklem büyüklükleri, olay pencereleri ve kümeleme problemleri altında karşılaştırılmıştır. Ayrıca, test sonuçlarının zaman dilimlerine, farklı veri tabanlarına (Datastream ve Matriks veri tabanları) ve istatistiksel araçlara (Excel ve Stata) hassaslığı da incelenmiştir. Bu çalışmada, Brown and Warner (1980; 1985) (bundan böyle BW) deneysel tasarımını takip edilmek ile birlikte güncel testler de kullanılmıştır.

Bu çalışma, BW metodolojisini gelişmekte olan bir piyasa için, hatta Türkiye için ilk defa kapsamlı bir şekilde geliştirerek literatüre katkı sağlamaktadır. Aynı zamanda bu tez, Türkiye Pay Piyasası'nı şekillendiren model hakkında bilgi vererek ileride yapılacak farklı politik veya ekonomik olayların Türkiye Pay Piyasası'nda etkilerini olay çalışması metodolojisi kullanarak test etmeyi amaçlayan çalışmalar için yol gösterici olacaktır. Literatür taramasında yer verilen ve Türkiye verisi ile olay çalışması metodolojisi kullanan çalışmalara bakıldığında farklı olayları değişik örneklemler kullanarak inceleyen çalışmalarda, anormal getiri hesaplamak için kullanılan model seçiminin bir hesaplamaya veya analize dayanmaması literatürde bir ihtiyaç olduğunu göstermektedir. Gümüş (2008) çalışması haricinde, Türkiye verisi ile hazırlanan 71 olay çalışmasının 32'sinde piyasa ile düzeltilmiş veriler açıklama yapılarak seçilmiş, fakat herhangi bir hesaplama veya metodolojik karşılaştırma yapılmamıştır. Bu sebeple, bu tez ile özellikle piyasayı en iyi tanımlayan model seçilmeden test sonuçlarının uygulanması ve yorumlanmasının yanlış sonuçlar ortaya çıkarabileceği belirtilmiştir. Ayrıca, Türkiye için hesaplanan getiriler normal olmayan özellikler göstermesine karşın parametrik olmayan testlerin katma değeri kısıtlı olmuştur.

Olay çalışması literatüründe Ball and Brown (1968) and Fama ve diğerlerinin (1969) çalışmaları metodolojiyi sunarken BW çalışmaları bu metodolojinin nasıl uygulanacağını göstermiştir. Binder (1998), Fama ve diğerlerinin çalışmasını finansta "metodolojik bir devrim" olarak tanımlarken BW da bu metodolojinin temellerini göstermiştir. 1980'e kadar yapılan çalışmalardan farklı olarak BW (1980) gerçek olaylar yerine 1944-1971 aylık verisini kullanarak rastgele seçilen aylardan olay ayını tayin etmiştir. Temel amacın modellerin performanslarının (ortalama ile düzeltilmiş, piyasa getirisi ile düzeltilmiş ve piyasa modeli) karşılaştırılması olduğu bu çalışmada her biri 50 menkul kıymetten oluşan 250 örneklem oluşturulmuş ve tahmin penceresi (-89,+10) olarak tanımlanmıştır. BW (1985) çalışması ise 1972-1979 dönemi günlük verileri kullanılarak aynı modellerin karşılaştırılmasını amaçlamıştır. Tahmin penceresinin (-244,-6), olay penceresinin ise (-5,+5) olarak tanımlandığı çalışmada belirli durumlarda ortalama ile düzeltilmiş getirilerin kullanılabileceği sonucuna varılmıştır.

BW metodolojisinin dizaynı temel olarak rastgele bir pay seçilmesi, bu pay için rastgele bir işlem günü (olay günü) seçilmesini ve bu işlemin her pay için tekrar edilmesinden ibarettir. Daha sonra, anormal getiri hesabında kullanılan modellerin karşılaştırılması amacıyla olay günü getirisi üzerine sabit bir getiri eklenir. Son olarak, olay penceresi üzerinde hesaplanan kümülatif anormal getiriler kullanılarak testler hesaplanır. Hesaplamalar ile test edilecek hipotez "anormal getiri yoktur" olduğundan, olay günü getirisine eklenen bir getiri olmadığı durumda (%0 eklenmesi durumu) boş hipotezin reddedilmemesi beklenecektir. Diğer taraftan olay günü getirisine %5 eklenmesi durumunda boş hipotezin reddedilmesi beklenecektir. BW dizaynında boş hipotezin reddedilme yüzdelerine bakılarak modellerin performansları karşılaştırılmıştır. Tip 1 hata boş hipotezin doğru olmasına rağmen reddedilmesi olasılığını, Tip 2 hata ise boş hipotezin yanlış olmasına rağmen reddedilmeme olasılığını göstermektedir. 1 eksi Tip 2 hata ise testin gücü olarak tanımlanırken Tip 1 hata spesifikasyon hakkında bilgi vermektedir.

BW çalışmasının önemine karşın bu çalışmayı takip eden uygulamalar sınırlı kalmıştır. Aynı metodoloji Kwok ve Brooks (1990) tarafından döviz piyasaları için uygulanmış, Corrado ve Truong (2008) ve Campbell ve diğerleri (2009) ise Amerika dışındaki ülkelerdeki hisse senedi getirilerini incelemişlerdir.

Kwok ve Brooks (1990) 1978-1988 döneminde 8 döviz kurunu incelemiş ve anormal getiriler günlük faiz oranları ve kurlar kullanılarak anormal getiriler hesaplanmıştır. Olay penceresinin (-5,+5), tahmin penceresinin ise (-55,-6) olarak tanımlandığı çalışmada, BW dizaynı takip edilerek 50 gözlemden oluşan 100 örneklem oluşturulmuş, ortalama ile düzeltilmiş, piyasa getirisi ile düzeltilmiş ve piyasa modeline ek olarak Uluslararası Fisher Etkisi'ni gösteren bir tesadüfi hareket modeli de karşılaştırılmıştır.

Corrado ve Truong (2008) çalışmasında ise 1994-2006 dönemi için Asya-Pasifik Piyasaları'nda aritmetik ve logaritmik getiriler ile piyasa modeli kullanılmıştır. Tahmin penceresi (-244,-5) olarak tanımlanarak, her piyasadan her bir menkul kıymet için belirli bir gün olacak şekilde 50.000 olay günü yaratılmıştır. Daha sonra 1000 portföy, 50.000 gözlemin içerisinden seçilerek yaratılmıştır. BW çalışmasına benzer şekilde farklı piyasa endeksleri, kümeleme problemi, olay gününe sabit bir getiri ekleme durumlarında testlerin güçleri karşılaştırılmıştır.

Campbell ve diğerleri (2009) 1988-2006 dönemi için 54 ülkeden günlük pay verisini kullanarak tüm verileri toplulaştırarak kullanmışlardır. Bu sebeple, piyasa endeksi olarak değer ağırlıklı bir endeks olan "seviye 1" Datastream Global Endeks serisini kullanmışlardır. BW dizaynına benzer şekilde piyasa ile düzeltilmiş getiriler ve piyasa modeli karşılaştırılmış, örneklem sayısı artırılarak 100 menkul kıymetten oluşan 1000 örneklem yaratılmıştır. (-256,-6) tahmin penceresi olarak kullanılırken, (-5,+5) olay penceresi olarak tanımlanmıştır. Olay penceresinde "anormal getiri yoktur" boş hipotezini test etmek için iki parametrik (Patell Z ve CDA) ve üç parametrik olmayan (genelleştirilmiş işaret ve sıralama testleri ve çakı testi) test kullanılmıştır.

Amerika dışındaki piyasalarda elde edilen bulgular, BW'da Amerika için elde edilenlerden farklılık göstermiştir. BW, belirli durumlarda ortalama ile düzeltilmiş getiriler kullanılmasını önermekle birlikte özellikle kümeleme problemi olması durumunda piyasa modelinin kullanılmasını önermiştir. Campbell ve diğerleri (2009) hem piyasa ile düzeltilmiş getirilerin hem de piyasa modelinin incelenen 54 ülke için iyi performans gösterdiğini belirtmiş, Corrado ve Truong (2008) ise Asya-Pasifik Piyasaları için eşit ağırlıklı piyasa endeksi kullanılan piyasa modelini üstün bulmuştur. Campbell ve diğerlerinin (2009) çalışması Amerika dışı piyasalar için BW metodolojisinin en kapsamlı olarak uygulandığı analiz olmakla birlikte bu çalışmada her bir ülkeye özgü sonuçlar verilmemiştir. 1988-2006 Türkiye verisinin de dâhil olduğu bu çalışmada, Türkiye verisi toplam örneklemin sadece %1,2'sini oluşturmaktadır. Bu sebeple, diğer piyasalar özellikle de gelişmekte olan piyasalar henüz yeterli şekilde incelenmemiştir.

Türkiye için yapılan çalışmalara bakıldığında ise Gümüş (2008) çalışması olay çalışması metodolojisi ile yapılmış diğer çalışmalardan farklı olarak BW dizaynının Türkiye üzerinde uygulaması üzerinde durmuş, 20 hisse senedinden oluşan 50 örneklem oluşturulmuştur. BW dizaynına benzer şekilde günlük veriler kullanılarak (-5,+5) olay penceresi ve (-244,-6) tahmin penceresi tanımlanmıştır. 1997-2007 dönemi için yapılan performans karşılaştırması (ortalama ile düzeltilmiş getiriler, piyasa ile düzeltilmiş getiriler ve piyasa modelleri için) sonucunda ortalama ile düzeltilmiş getirilerin en iyi performansı sergilediği gözlenmiştir. Fakat bu çalışma daha çok bir başlangıç çalışması niteliğinde olup getiri hesaplama yöntemi, örneklem büyüklüğü, olay penceresi uzunluğu, kümeleme problemi gibi konulara yer verilmemiştir. Özellikle ham verinin düzenlenmesi ve "temiz" bir veri seti yaratılması konusundaki hususlar Gümüş (2008) çalışmasında bulunmamaktadır.

Oran ve Soytaş (2008) tarafından yapılan başka bir çalışmada simülasyon bazlı bir metot ile İMKB'de hisse senedi ve portföy bazında beta katsayısının istikrarlılığı test edilmiştir. Her bir hisse senedi için rastgele 500 olay günü yaratılmış ve her bir olay günü için yerine koyma metodu ile hisse senedi seçilmiştir. İMKB-100 endeksi ile piyasa modeli, olay günü civarındaki 500 işlem günü üzerinde regresyon ile tahmin edilmiştir. Fakat bu çalışmanın esas amacı metodolojik karşılaştırma yerine beta katsayıları olmuştur.

Bu tezde de BW dizaynında olduğu gibi ortalama ile düzeltilmiş, piyasa getirisi ile düzeltilmiş ve piyasa modeli karşılaştırılmıştır. Olay çalışmasının temelinde anormal getirilerin hesaplanması olduğundan ilk aşama olarak beklenen veya "normal" getirilerin bir metot ile belirlenmesi gerekmektedir. Literatüre bakıldığında, bütün problemleri çözen kapsayıcı tek bir modelden söz etmek mümkün değildir. Buna karşın Binder (1998) yanlış model seçilmesi durumunda ciddi spesifikasyon hatalarının ortaya çıkacağını belirtmiştir. Bu hataya bağlı olarak yapılacak çıkarımlar da yanıltıcı olacağından olay çalışmasında model seçimi yorumların güvenilirliği açısından önem taşımaktadır.

Pratik bir kural olarak piyasa ve risk düzeltmesi yapılan modeller (Sermaye Varlıkları Fiyatlama Modeli, Arbitraj Fiyatlandırma Modeli gibi) herhangi bir piyasa veya risk düzeltmesi olmayan modellere göre daha üstün performans göstermektedirler (Armitage, 1995). Fakat Armitage (1995) piyasa modelinin ötesinde kompleks modellerin veya düzeltmelerin performans üzerinde çok az bir etkisi olacağını belirtmiştir. Bu sebeple, bu tezde de ilk aşama olarak sadece üç model üzerinde durulmuştur.

Türkiye için daha önce olay çalışması metodolojisi ile yapılan araştırmalara bakıldığında çoğunlukla (71 çalışmanın 32'si) piyasa getirisi ile düzeltilmiş getiriler ve piyasa modeli (25 çalışma) uygulandığı görülmüştür. Buna karşın sadece 2 çalışmada üç model de göz önüne alınmıştır.

Bu tezde deneysel plan olarak, BW dizaynında olduğu gibi her biri 50 hisse senedinden oluşan 250 örneklem oluşturulmuştur. Menkul kıymetler veri seti içerisinden rastgele ve yerine koyma yöntemi ile seçilmiştir. Bu sebeple, bir hisse senedi birden fazla örneklemde farklı bir olay günü ile yer alabilmektedir. Diğer taraftan, kümeleme problemi incelenirken örneklem içerisinde herhangi bir sapma olmaması amacıyla hisse senedi seçiminde yerine koymadan örneklemler oluşturulmuştur. Her bir hisse senedi için rastgele olay günü 4 Ocak 1988-24 Şubat 2012 döneminde hisse senedinin işlem gördüğü günlerden birinin rastgele (eşit olasılıkla) seçilmesi ile belirlenmiştir. Olay günü t=0 gününü temsil etmekle birlikte tahmin penceresi olay gününden 244 ve 6 gün öncesi arasındaki dönem ((-244,-6)) olarak tanımlanmıştır. Olay penceresi ise (-5,+5) olarak tanımlanmıştır. Bu dizayna bağlı olarak her bir hisse senedi için 250 günlük getiri kullanılmıştır.

4 Ocak 1988-24 Şubat 2012 dönemi getirileri analiz için kullanılmadan önce altı kriter uygulanarak "temizlenmiş" bir veri seti elde edilmiştir:

Kriter 1: 4 Ocak 1988-24 Şubat 2012 döneminde toplam 250 gözlemden (getiriden) az gözleme sahip olan paylar veri setinden çıkarılmıştır.

Kriter 2: Tahmin penceresi üzerinde 50 getiriden az gözleme sahip olan paylar veri setinden çıkarılmıştır.

Kriter 3: %1000'den büyük veya -100%'den küçük olan günlük getiriler veri setinden çıkarılmıştır[53].

[53] Bu kriter, Corrado ve Truong (2008) tarafından tanımlanan bir kriter olup hatalı girişleri temizlemek amacı ile koyulmuştur. Borsa İstanbul'daki mevcut fiyat limiti uygulaması gereği bu büyüklükteki fiyat değişimlerinin olmaması beklenmelidir.

Kriter 4: Tahmin ve olay pencerelerinin toplamında 30'dan fazla ardışık eksik getirisi olan paylar veri setinden çıkarılmıştır.

Kriter 5: Tahmin ve olay pencerelerinin toplamında 90'dan fazla ardışık sıfır getirisi olan paylar veri setinden çıkarılmıştır.

Kriter 6: Olay penceresi üzerinde eksik getirisi olan paylar veri setinden çıkarılmıştır (tam olay penceresi durumu).

Tüm bu kriterler uygulandıktan sonra bile örneklem dizaynı gereği verisi tam olan şirketlerin seçilmesi yönünde bir eğilim olacaktır.

Anormal getiri hesaplamasında kullanılan modeller olarak ortalama ile düzeltilmiş, piyasa getirisi ile düzeltilmiş ve piyasa modeli karşılaştırılmıştır. Ortalama ile düzeltilmiş getiriler, tahmin penceresi üzerinde hesaplanan ortalamayı "normal" getiri olarak varsayarak olay penceresinde gerçekleşen getirilerden normal getirinin çıkarılması ile hesaplanmıştır. Diğer taraftan piyasa getirisi ile düzeltilmiş getiriler için beklenen getiri olarak endeks getirisi kullanılmıştır. Son olarak, piyasa modelinde tahmin penceresi üzerinde tahmin edilen piyasa modelinin katsayıları kullanılarak olay penceresi getirileri üzerindeki anormal getiri hesaplanmıştır.

Hem piyasa ile düzeltilmiş getirilerin hesaplanmasında hem de piyasa modeli katsayılarının elde edilmesinde piyasayı temsilen Borsa İstanbul-100 (BİST-100) endeksi kullanılmıştır. Daha önce Türkiye için olay çalışması metodolojisi ile yapılan çalışmalara da bakıldığında, incelenen 71 çalışmanın 54'ünde İMKB-100 (Nisan 2013 sonrasında BİST-100) kullanıldığı gözlenmiştir. Sadece 4 çalışmada BİST-TÜM endeksi kullanılmıştır. Diğer hesaplamalarda ise kullanılan model sebebi ile piyasa değerine yer verilmemiştir veya yeterli açıklama yapılmamıştır.

Campbell ve diğerleri (2009) tarafından yapılan çalışmada incelenen 18 olay çalışmasından 16'sında en az bir parametrik test kullanıldığı belirtilmiştir. Ayrıca, bu çalışmaların 7'sinde hem parametrik hem parametrik olmayan testler bir arada kullanılmıştır. Türkiye için incelenen 71 olay çalışmasının 11'inde de parametrik olmayan testlere yer verilmiştir. Bu sebeple, bu tezde de hem testin spesifikasyonu hem de gücü üzerindeki etkisi görmek amacı ile iki parametrik (portföy zaman serisi standart sapma testi ve Patell testi) ve iki parametrik olmayan test (genelleştirilmiş işaret ve genelleştirilmiş sıralama testi) kullanılmıştır. Parametrik olan testler getirilerin dağılımından etkilenirken parametrik olmayan testler dağılımdan bağımsızdır.

Parametrik olan testlerden biri olan portföy zaman serisi standart sapma testi, BW çalışmalarında Ham Bağımlılık Düzeltmesi Testi (Crude Dependence Adjustment-CDA) olarak tanımlanmıştır. CDA test değeri, olay penceresi üzerindeki kümülatif anormal getirilerin ilgili standart sapmaya bölünmesi ile hesaplanmaktadır. Anormal getiriler normal, birbirinden bağımsız ve özdeşçe dağılım gösterdiği sürece test değeri de t-dağılımında olmaktadır. Patell (1976) tarafından geliştirilmiş olan bir diğer parametrik test olan Patell Z Testi ise getirilerin menkul kıymetler için seçilmiş olaylar bazında birbirinden bağımsız olduğunu varsaymaktadır. Standart hale getirilen anormal getiriler ile hesaplanan test değeri, t-dağılımı özelliklerini göstermektedir. CDA testinde hesaplanan varyans değeri sabit bir değer olup menkul kıymetlerin birbirinden farklı varyans değerlerine duyarlı değildir. Diğer taraftan, Patell testinde kullanılan standart sapma olay penceresinin her günü için menkul kıymet bazında hesaplanmaktadır.

Parametrik olmayan testlerin parametrik olanlara göre daha iyi performans gösterdiğini ifade eden çalışmaları (Corrado ve Truong, 2008; Campbell ve diğerleri, 2009) takip ederek genelleştirilmiş işaret ve sıralama testleri de hesaplanmıştır. McConnell ve Muscarella (1985) and Lummer ve McConnell (1989) tarafından önerilen genelleştirilmiş işaret testi getirilerin dağılımı hakkında bir varsayım yapmamakta, sadece tahmin penceresinde pozitif anormal getiri gözlenen gün sayısı oranını olay penceresindeki oran ile karşılaştırmaktadır. Test değeri ile sınanan boş hipotez ilgili oranın hem tahmin hem de olay penceresinde eşit olmasıdır. Corrado'nun (1989) genelleştirilmiş sıralama testi, genelleştirilmiş işaret testine benzer şekilde getiriler için normal dağılım varsayımı yapmamaktadır. Fakat bu test ile anormal getirinin işareti yerine her bir anormal getirinin tahmin ve olay pencerelerinin bütünündeki sırası dikkate alınmaktadır. Bir günden daha uzun olay pencereleri için Cowan (1992) tarafından yapılan düzeltme ile test değeri hesaplanmıştır.

Cowan (1992) genelleştirilmiş sıralama testinin ideal durumda genelleştirilmiş işaret testinden daha iyi sonuçlar vereceğini, uzun olay penceresi, olay penceresinde getiri varyansında bir artış olması ve az işlem görme (likiditenin az olması durumunda) ise genelleştirilmiş işaret testinin tercih edilebileceğini ifade etmiştir.

Datastream veritabanı kullanılarak 1988-2012 döneminde Borsa İstanbul'da işlem gören 471 hisse senedi için 1,475,196 logaritmik getiri elde edilmiştir. Fiyat verisi olarak, öz sermaye durumlarına göre düzeltilmiş olan veri tipi P kullanılmıştır. 471 menkul kıymetin içerisinde borsa yatırım fonları da yer almakta olup herhangi bir sektör sınıflamasına gidilmemiştir. Fakat örneklemde öne çıkanın 46 şirket ile finansal hizmetler sektörü olduğu gözlenmiştir. Getiri hesaplamasında, bir önceki en son işlem günü değeri baz alınmıştır.

Datastream veri tabanından alınan fiyat verisi incelendiğinde verilerin direkt olarak analizde kullanılmasının önünde bazı engeller olduğu görülmüştür: işlem sırası kapanan şirketlerin belirlenmesi, bazı fiyat alanlarında "NA (geçerli olmayan)" ve "0" şeklinde girişler olması ve Borsa İstanbul tarafından sağlanan dosyalar ile aralarındaki tutarsızlıklar. Borsa İstanbul tarafından düzeltilmiş fiyat verisi yayınlanmaması sebebi ile tüm bu durumlar için Datastream veri seti üzerinde manüel düzenlemeler yapılarak kullanılmıştır.

471 hisse senedi için ilgili kriterler uygulandıktan sonra 388 hisse senedi için 1,381,797 logaritmik ve 1,381,822 aritmetik getiri elde edilmiştir. Logaritmik ve aritmetik getiriler arasındaki bu fark, aritmetik ve logaritmik getiri hesabındaki farklılık ile uygulanan kriterlerin bazı gözlemleri veri setinden atmasından kaynaklanmaktadır. Elde edilen sonuçlara göre, yüzde 0 getirilerin oranı tüm örneklem içerisinde %35 olup getiriler, Muradoğlu ve Ünal (1994) ve Campbell ve diğerleri (2009) çalışmalarında da bulunduğu gibi, normal olmayan özelliklere sahiptir. Corrado ve Truong (2008) çalışması ile karşılaştırılacak olursak %0 getiri oranı Malezya veya Singapur gibi ülkelere göre katlanılabilir düzeyde olmakla birlikte Amerika, Japonya ve Kore'ye göre yüksektir. Türkiye'nin de dâhil olduğu Campbell ve diğerleri (2009) çalışmasında ise bu oran 1988-2006 dönemi için %19,4 olarak

verilmiştir. 371 pay için veri kaynağı olarak Datastream kullanılan çalışmada, Datastream ile ifade edilen veri girişlerindeki sorunlar ile ilgili olarak ne yapıldığına yer verilmemesi sebebi ile bu tez ile birebir karşılaştırma yapılamamaktadır. Bu farkın bir sebebi Campbell ve diğerleri (2009) çalışmasında az işlem gören payların analizin başında veri setinden çıkarılması olabilir. Diğer taraftan, önceki çalışmalara benzer şekilde, getiri ortalaması yaklaşık %0 (%1'in altında) ve standart sapma %5 civarındadır.

Aritmetik ve logaritmik getiriler kullanılarak test sonuçları karşılaştırıldığında hem spesifikasyon hem de test gücü açısından her iki yönde de değişim olması sebebi ile aritmetik veya logaritmik getiri sonuçları daha iyi performans göstermektedir şeklinde bir sonuca ulaşılamamıştır. Fakat Corrado ve Truong (2008) tarafından Asya-Pasifik Piyasaları için de bulunduğu üzere aritmetik getiriler için hesaplanan çarpıklık ve basıklık değerleri normal dağılımdan daha büyük bir sapmaya işaret etmektedir. Ayrıca, diğer ülkelerde olduğu gibi aritmetik getiriler ile hesaplanan ortalama ve standart sapma değerleri logaritmik getiriler ile hesaplanan değerlerden daha büyüktür.

BW sonuçları ile karşılaştırılsa (aritmetik getiriler ile CDA testi sonuçları) Türkiye verisi ile spesifikasyon hatası biraz daha fazla test gücü biraz daha düşüktür (Tablo 1). Olay gününde %2 sabit getiri eklendiğinde test gücü yaklaşık %85 iken bu oran BW'da %100 olarak belirtilmiştir. Diğer bir deyişle, BW sonuçlarına göre CDA testi ile gerçekten anormal getiri olması durumunda %100 olasılıkla getiri tespit edilebilirken bu olasılık Türkiye için %85'e düşmektedir. BW ve bu tezde belirtilen sonuçlar arasında büyük bir değişim olmamasına rağmen bu farkın bir sebebi Türkiye Pay

Piyasası için daha az spesifikasyon hatası ve daha güçlü sonuçların elde edilebileceği farklı metotların uygulanmasını gerektiren Amerika ve Türkiye piyasaları arasındaki farklılıklar olabilir.

Tablo 1. Aritmetik Getiri ve CDA Testi ile Modellerin Karşılaştırılması

Model	**Sabit getiri miktarı (t=0 zamanında eklenmesi durumunda)**			
BW Sonuçları	**0%**	**0.5%**	**1%**	**2%**
Ortalama ile düzeltilmiş getiriler	6.4%	25.2%	75.6%	99.6%
Piyasa ile düzeltilmiş getiriler	4.8%	26.0%	79.6%	99.6%
Piyasa Modeli	4.4%	27.2%	80.4%	99.6%
Türkiye Pay Piyasası Sonuçları	**0%**	**0.5%**	**1%**	**2%**
Ortalama ile düzeltilmiş getiriler	6.0%	15.2%	32.8%	81.2%
Piyasa ile düzeltilmiş getiriler	7.2%	16.8%	37.2%	88.4%
Piyasa Modeli	7.6%	13.2%	34.4%	84.8%

Not: Her bir yüzde 250 örneklemin yüzde kaçında boş hipotezin ("olay penceresi üzerinde anormal getiri yoktur") reddedildiğini göstermektedir. Her bir örneklemin büyüklüğü 50, anlamlılık düzeyi ise %5'tir. Hisse senetleri ve olay günleri rastgele olarak seçilmiştir. BW çalışmasında 1962-1979 dönemi için tüm CRSP verisi kullanılarak yapılmıştır.

Her bir örnekleme dâhil edilen hisse senedi sayısı 50'den 20'ye düşürüldüğünde, BW sonuçlarında da olduğu gibi, spesifikasyon hatası açısından büyük bir değişim olmamaktadır. Diğer taraftan, Kothari ve Warner (2006) çalışmasında örneklem büyüklüğü arttıkça testin gücünün de artacağı belirtilmiştir. Bu bulguya benzer şekilde testlerin gücünün arttığı gözlenmiştir. Tüm testler için örneklem küçüldükçe testlerin gücü de azalmaktadır (kesin artan fonksiyon). Bu sebeple Türkiye Pay Piyasası hakkında olay çalışması yapmak isteyen bir araştırmacının 50 hisse senedinden oluşan örneklemleri 20 hisse senedinden oluşan örneklemlere tercih etmesi gerekmektedir.

Farklı olay pencerelerinin karşılaştırılması, olay çalışması metodolojisinde ilgili olayın veya bilginin belirtilen kısa dönem içerisinde piyasa katılımcıları tarafından öğrenildiğini varsayması bakımından önem taşımaktadır. Hâlbuki bilginin sızması veya olay hakkında önceden beklentilerin olması durumunda olay çalışması sonuçları veya kullanılması gereken metotlar değişebilmektedir. Edmans ve diğerleri (2009) ve Cornett ve diğerleri (2011) çalışmalarında şirket satın almalarında yatırımcı öngörülerinin olay penceresinde kümülatif anormal getirileri etkilediği bulunmuştur. Mulherin ve Simsir (2013), şirket birleşmelerinde doğru tanımlanmış olay penceresinin önemine işaret etmişlerdir. Menkul Kıymet Veri Şirketi'nden alınan (Securities Data Corporation) birleşme duyurularının olay günü ("duyuru günü") olarak kullanıldığı sonuçlar ile birleşme ile alakalı olaylardan yola çıkarak tespit edilen olay günü ("orijinal duyuru günü") sonuçları arasında kümülatif anormal getiri açısından büyük farklar olduğu gözlenmiştir. Ayrıca, koşula bağlı olay çalışması metotları şirketlerin öz sermaye hallerini etkileyen durumlarda bilinçli olarak seçimler yaptıklarını ve piyasaya bilginin şirket istediği zaman duyurulduğunu ifade etmektedirler (Acharya, 1988; 1993; Eckbo ve diğerleri, 1990).

Bu sebeple farklı olay pencereleri ((-5,+5), (-1,+1) ve bir günlük olay penceresi) karşılaştırılmış ve BW sonuçlarına benzer şekilde, spesifikasyon hatasında büyük bir değişim olmadığı fakat olay penceresinin kısalması ile testlerin gücünün önemli miktarda arttığı gözlenmiştir. Bu analizde önemli bir varsayım olay penceresi kısalırken olay gününün daima t=0 olarak belirlenmiş olması, bu sebeple olay gününün kesinlikle olay penceresi içerisinde yer almasıdır. BW dizaynında 1 günden uzun olan olay pencerelerinde olay günü pencere içerisinde rastgele herhangi bir işlem günü olarak tanımlanmıştır. Fakat testlerin olay pencereleri üzerindeki kümülatif anormal getiriler üzerinden hesaplanması sebebi ile dizaynlar arasındaki farklılık testlerin karşılaştırılması üzerinde etkili değildir.

Bir örneklemde yer alan tüm hisse senetleri için aynı olay gününün tayin edilmesi ile ortaya çıkan kümeleme problemi yaratıldığında spesifikasyon hatalarının büyük miktarda arttığı, testlerin gücünün ise düştüğü görülmüştür. Bu sebeple, kümelemenin test sonuçlarını etkilediği görülmüş ve Türkiye Pay Piyasasında yapılacak çalışmalarda dikkat edilmesi ve kaçınılması gereken ciddi bir problem olarak yorumlanmıştır. Kümeleme olması durumunda ortalama ile düzeltilmiş getirilerin performansının düşük olduğu ve Türkiye verisi ile yapılacak bir çalışmada tercih edilmemesi gerektiği gözlenmiştir. Örneğin, Türkiye’de enflasyon açıklamalarının pay getirileri üzerindeki etkisi üzerine yapılacak bir çalışmada anormal getiri hesaplamasında piyasa ile düzeltilmiş getiriler veya piyasa modeli kullanılması gerekmektedir.

1999-2012 dönemine ek olarak İMKB tarihindeki önemli gelişmeler göz önünde bulundurularak bahsi geçen tüm durumlar 1999-2012 dönemi için de hesaplanmıştır. İMKB tarihine bakıldığında 1994 yılında işlemlerde tam otomasyona geçilmesi, 1999 yılında ise marjin ve açığa satış işlemlerinin başlaması belirli dönüm noktaları arasındadır. Özellikle 1999 yılından sonra borsa yatırım fonlarının işlem görmesi, değişik endekslerin hesaplanması ve otomatik devre kesici sistemlerinin uygulanması gibi pek çok gelişme yaşanmıştır. Bu sebeple, 1999-2012 dönemi ayrıca incelenmiştir.

Zaman aralığı 1988-2012'den 1999-2012 dönemine indirildiğinde spesifikasyon hatalarında önemli bir değişiklik olmamıştır, hatta genelleştirilmiş sıralama testi için hatada artış olmuştur. Genelleştirilmiş sıralama testi dışında tüm testlerin gücünde, getirilerin standart sapmalarındaki düşüşe istinaden bir artış olmuştur. Genelleştirilmiş sıralama testindeki bu farklılığın sebebi getirilerin varyansındaki bir artış olabilir (Cowan, 1992). Serra (2002), getiri varyansında artış olması durumunda parametrik testlerin genelleştirilmiş sıralama testinden daha iyi performans gösterebileceğini belirtmiştir. Cowan ve Sergeant (1996) da varyans artışları olması durumunda genelleştirilmiş sıralama testinin spesifikasyon hatasının olacağını belirtmiştir. 1999-2012 dönemi için genel olarak piyasa modeli en iyi performans gösteren model olmuştur.

Tüm senaryolar Matriks veri tabanından alınan veriler ile de tekrar analiz edilmiştir. Matriks, Borsa İstanbul'un yurt içi veri dağıtıcılarından biri olup düzeltilmiş fiyat verisini de sağlamaktadır. Her veri tabanı kendi metodolojisi ile düzeltilmiş fiyat verisini hesaplasa da Datastream'e alternatif olarak Matriks verileri kullanılmıştır. Metodoloji farklılıkları sebebi ile iki veri tabanından alınan fiyat verileri her işlem günü için aynı değerleri vermemektedir. Örneğin, ADEL kodlu hisse senedi için ilk fiyat verisi Datastream'de 18 Haziran 1996'da 0,28 olarak verilirken Matriks'de ise 0,11 olarak girilmiştir.

Datastream ve Matriks veri tabanlarındaki veri Borsa İstanbul internet sitesinde yer alan veriler ile karşılaştırıldığında da bazı farklılıklar gözlenmiştir. Örneğin, "ACIBD" kodlu pay için ilk işlem tarihi 15 Haziran 2000 iken bu tarih Datastream veri tabanında 6 Temmuz 2000 olarak girilmiştir. Ne var ki Borsa İstanbul tarafından sağlanan dosyalara bakıldığında ACIBD ilk işlem tarihi 15 Haziran 2000'dır. Bu örnek için Matriks tarafından sağlanan tarih doğru olmak ile birlikte bir diğer kod olan "ADANA" için her iki veri tabanının yazmış olduğu tarih Borsa İstanbul tarafından sağlanan tarih ile örtüşmemektedir. Her ne kadar bu gibi durumları ortadan kaldırmak ve güvenilir veri ile analiz yapmak için direkt Borsa tarafından sağlanacak olan veri setine ihtiyaç duyulsa da Borsa'nın henüz düzeltilmiş fiyat verisi yayınlaması sebebi ile Matriks bir diğer alternatif olarak seçilmiştir.

Matriks tarafından sağlanan verinin en önemli eksikliği sadece halen işlem gören hisse senetlerin fiyat bilgisinin verilmesidir. Bu sebeple, geçmiş dönemde işlem görmüş paylara ilişkin veriler bulunmamaktadır. Datastream tarafından 471 hisse senedine ait veri alınmışken, Matriks'ten 396 hisse senedine ait fiyat bilgisi alınmıştır. Bu sebeple, her iki veri tabanı sonuçlarının birebir karşılaştırma sağlamadığına dikkat edilmelidir.

Matriks veri tabanı sonuçlarına göre, Borsa İstanbul'un ilk yıllarında işlem görmüş fakat mevcut durumda işlem görmeyen şirketlerin örneklemde bulunmaması sebebi ile %0 getirilerin oranı daha düşüktür. Datatream yerine Matriks verisi kullanmanın spesifikasyon hatası açısından herhangi bir faydası yoktur. Diğer taraftan, Matriks verisi ile testlerin güçlerinde az da olsa bir artış gözlenmiştir. Modeller arasındaki farklar da Matriks verisi kullanıldığında azalmıştır. Aslında bu sonuç belirli durumlar altında ortalama ile düzeltilmiş getirilerin kullanılmasına sonucuna varan BW çalışmasını desteklemektedir.

Diğer taraftan, Matriks veri tabanı kullanıldığında da elde edilen diğer sonuçlar ilk bulguları desteklemektedir: 50 hisse senedinden oluşan örneklemler 20 paydan oluşan örneklemlere göre tercih edilmiş, kısa olay pencerelerinin testlerin gücünü arttırdığı gözlenmiş ve kümeleme probleminin sonuçlar üzerinde yanıltıcı bir etki bıraktığı bulunmuştur.

Son olarak, Stata kodları ile elde edilen sonuçlar Excel sonuçları ile karşılaştırılmış ve ortalama ile düzeltilmiş verilerin ciddi bir spesifikasyon ve güç problemi yaratmadığı sonucu desteklenmiştir. Stata kodları ile elde edilen yüzdelerin ise Excel kodları ile belirtilen sonuçlardan farklılık göstermesi ise her iki programda rastgele seçimler yapılırken kullanılan algoritma farklılığından kaynaklanmaktadır. Stata kodlarına ek olarak, mevcut Excel kodları kullanılarak kullanıcı tarafından olay günlerinin girilerek test değerlerinin hesaplanabileceği ve olay çalışmasının dizayn edilebileceği bir dosya da yaratılmıştır.

Bu tezde farklı modellerin performanslarının karşılaştırılması amaçlandığı için son finansal krizin etkileri ayrıca incelenmemiştir. Deneysel dizaynda tamamen rastlantısal seçilen günlerin kullanılması sebebi ile krizin etkisinin kısıtlı olması beklenmektedir. Buna karşın rastgele seçilen olay günlerinin kriz döneminde ne kadar yoğun olduğunu kontrol etmek için 250x50 dizaynında olay günlerinin dağılımına bakılmıştır. Bir hisse senedinin seçilebilmesi için belirli kriterler uygulanması sebebi ile olay günlerinin 2000 sonrasında yoğunlaştığı fakat özellikle kriz döneminde farklı bir dağılım olmadığı gözlenmiştir.

İncelenen tarih aralığında önemli olabilecek bir başka husus ise İMKB tarafından 1987'de uygulanmaya başlanan fiyat marjin uygulamasıdır. Düzenleme gereği fiyat marjini %10 olarak sınırlanmış, fakat bu tezde 1988'den başlayan fiyat serisi kullanıldığından fiyat limiti uygulamasında bir değişiklik olmamıştır. Bu sebeple, uygulama değişikliği gibi bir durum tez kapsamında incelenmemiştir.

Fiyat limiti düzenlemesine ek olarak, 2011 yılı başında "İMKB Otomatik Devre Kesici Sistem" uygulaması başlamıştır. Olay günlerinin dağılımına bakıldığında sadece 12.795 olay gününün 2010 sonrasına denk geldiği ve toplam olay günlerinin %11,6'sının bu döneme denk geldiği görülmüştür. Ayrıca, işlemlerin durdurulmasının gün içi fiyat oluşumunda etkili olması buna karşın bu çalışmada günlük veri kullanılması sonuçlar üzerinde kısıtlı bir etkisi olacağını göstermektedir.

Tablo 2'de parametrik ve parametrik olmayan testlerin yukarıda bahsedilen farklı senaryolar altında karşılaştırması özetlenmiştir. Çoğu durumda portföy zaman serisi standart sapma testinin (CDA) spesifikasyon açısından en iyi performans gösteren test olması, varyans artışları sebebi ile parametrik testlerin parametrik olmayan testlere daha iyi sonuçlar vermesi görüşünü desteklemektedir. Borsa İstanbul için elde edilen bu bulgular, Corrado ve Truong'un (2008) Asya-Pasifik Piyasaları, Campbell ve Wasley'in (1993) Nasdaq, Maynes ve Rumsey'in (1993) Toronto Borsası, Bartholdy ve diğerlerinin (2007) ise Kopenhag Borsası için bulmuş olduğu parametrik olmayan testlerin parametrik testlere göre daha iyi performans göstermesi sonucunu desteklememektedir. Borsa İstanbul için getiriler her ne kadar normal olmayan bir dağılıma sahip olsalar da hem bir parametrik test olan CDA testi hem de parametrik olmayan genelleştirilmiş sıralama testi benzer spesifikasyon hatalara sahiptir. Bu durumun bir açıklaması yukarıda da belirtildiği üzere Serra (2002) ve Cowan ve Sergeant (1996) tarafından açıklanan getirilerdeki varyans artışı olabilmektedir. Türkiye verisi için Tablo 2'de seçilen testler sadece CDA ve genelleştirilmiş sıralama testleri olduğundan (parametrik olmayan testlerin parametrik testlere göre daha üstün performans göstermemesi sebebi ile) Türkiye Pay Piyasası için hem parametrik hem de parametrik olmayan testlerin birlikte kullanılması önemlidir.

Tablo 3'de ise modellerin performanslarının karşılaştırması hakkında elde edilen tüm sonuçlar özetlenmiştir. BW'da olduğu gibi sonuçlar, belirli durumlarda ortalama ile düzeltilmiş getirilerin bir spesifikasyon ve güç problem yaratmadığını, fakat belirli senaryolarda (özellikle kümeleme problemi olması durumu) yanıltıcı sonuçlar elde etmemek için piyasa modelinin veya piyasa getirisi ile düzeltilmiş getirilerin kullanılması gerektiğini göstermektedir.

Tablo 2. Testlerin Farklı Durumlarda Karşılaştırılması

	En iyi spesifikasyon/tanımlamaya sahip test(ler)
Logaritmik ve aritmetik getiriler	Portföy zaman serisi standart sapma testi (CDA) & Genelleştirilmiş sıralama testi
20 hisse senedinden oluşan daha küçük örneklemler (logaritmik ve aritmetik getiriler ile)	CDA
Daha kısa olay penceresi ((-1,+1)) ve bir günlük olay penceresi (logaritmik ve aritmetik getiriler ile)	CDA & Genelleştirilmiş sıralama testi
Kümeleme problemi (logaritmik ve aritmetik getiriler ile)	CDA
1999-2012 dönemi (logaritmik ve aritmetik getiriler ile)	CDA
Matriks veri tabanı (logaritmik ve aritmetik getiriler ile)	CDA
Matriks veri tabanında 20 hisse senedinden oluşan daha küçük örneklemler (logaritmik ve aritmetik getiriler ile)	CDA
Matriks veri tabanında daha kısa olay penceresi ((-1,+1)) ve bir günlük olay penceresi (logaritmik ve aritmetik getiriler ile)	CDA
Matriks veri tabanında kümeleme problemi (logaritmik ve aritmetik getiriler ile)	CDA
Stata kodları (logaritmik ve aritmetik getiriler ile)	CDA

Tablo 3. Testlerdeki Spesifikasyon Hatasına Göre Modellerin Karşılaştırılması

	CDA	Patell-Z	Genelleştirilmiş İşaret Testi	Genelleştirilmiş Sıralama Testi
Logaritmik getiriler	OD	OD	OD	OD
Aritmetik getiriler	OD	OD & PD	OD	OD
20 hisse senedinden oluşan daha küçük örneklemler (logaritmik ve aritmetik getiriler ile)	PM	PM	PM	PD
Daha kısa olay penceresi ((-1,+1)) ve bir günlük olay penceresi (logaritmik ve aritmetik getiriler ile)	PD & PM	PM	PM	PD & PM
Kümeleme problemi (logaritmik ve aritmetik getiriler ile)	PD	PD & PM	PM	PD
1999-2012 dönemi (logaritmik ve aritmetik getiriler ile)	PM	PM	PM	PD
Matriks veri tabanı (logaritmik ve aritmetik getiriler ile)	Her 3 model yakın sonuç vermiştir	PD	PD & PM	OD & PD

Tablo 3'ün devamı

	CDA	Patell-Z	Genelleştirilmiş İşaret Testi	Genelleştirilmiş Sıralama Testi
Matriks veri tabanında 20 hisse senedinden oluşan daha küçük örneklemler (logaritmik ve aritmetik getiriler ile)	PM	PM	PD	PD
Matriks veri tabanında daha kısa olay penceresi ((-1,+1)) ve bir günlük olay penceresi (logaritmik ve aritmetik getiriler ile)	PD	PD	OD & PM	Her 3 model yakın sonuç vermiştir
Matriks veri tabanında kümeleme problemi (logaritmik ve aritmetik getiriler ile)	PD	PM	PM	PD

Not: OD: ortalama ile düzeltilmiş getiri, PD: piyasa ile düzeltilmiş getiri, PM: piyasa modeli

Tüm bulgular içerisinden çıkarılacak en faydalı sonuç piyasa katılımcıları açısından olmaktadır: Türkiye Pay Piyasası'nı karakterize eden modelin belirlenmesi. BW tarafından Amerika için bulunduğu gibi, Türkiye için de ortalama ile düzeltilmiş getirilerin önemli bir spesifikasyon ve güç problemi yaratmadığı gözlenmiştir. Aritmetik getiriler ve CDA testi kullanılarak Türkiye Pay Piyasası'nda %1'lik anormal getirilerin (gerçekten de anormal getiri olması durumunda) %33'lük olasılık ile tespit edilmesi mümkündür. Bu olasılık %2'lik anormal getiri olması durumunda %81'e ulaşmaktadır. Bu sebeple, Türkiye için yapılacak çalışmalarda araştırmacı olayın yapısı ve getiriler üzerindeki etkisi hakkında bilgi sahibi olmalıdır. Getiriler üzerinde %0.5 anormal getiri gibi çok ufak değerlerde etkisi olacak bir olayın olay çalışması ile analiz edilmesi durumunda testlerin gücü çok düşük (yaklaşık %15 civarında) olacaktır.

Elde edilen bulgulardan ortaya çıkan bir diğer pratik sonuç ise kümeleme problemi olması durumunda seçilecek olan modeldir. Genellikle enflasyon duyuruları veya Merkez Bankası kararları gibi makroekonomik olayların etkisinin analizinde ortaya çıkan kümeleme problemi olması durumunda Türkiye verisi için olay çalışması çok dikkatli bir şekilde uygulanmalı ve ortalama ile düzeltilmiş veriler tercih edilmemelidir.

Bir diğer pratik sonuç ise sonuçların farklı veri tabanlarına olan duyarlılığıdır. Özellikle ampirik çalışma yapanların farklı veri tabanlarını kullanırken veri tabanlarını içeriği hakkında dikkatli olmaları gerekmektedir. İki farklı veri tabanından (Datastream ve Matriks) elde edilen sonuçlara göre düzeltilmiş fiyat serisinin elde edilişindeki farklılıkların piyasayı tanımlayan modelin seçiminde de etkili bulunmuştur.

Bu çalışmanın devamı olarak, eşit ağırlıklı piyasa endeksi, değişik kompleks modeller ve farklı parametrik ve parametrik olmayan testler kullanılarak kapsamı genişletilmelidir. Özellikle, veri tabanlarının karşılaştırılması, veri tabanında yer alan tüm veriler yerine her veri tabanından tamamen aynı hisse senetlerinin seçilmesi ile tekrarlanabilir. Bu tez ile Türkiye Pay Piyasası'nı anlamak için atılan ilk adımın ardından farklı ülkeler veya ülke grupları için de ortak hususların bulunması için analizler yapılması faydalı olacaktır.