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«LONG RUN EVENT STUDIES AND THE ISSUE OF OVERLAPPING AND CROSS SECTIONAL CORRELATION IN RETURNS»

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Αφιερώνεται στην οικογένεια μου,

στην Ανδριάνα και στην Χρύσα.

ABSTRACT

This paper focuses on the description of various technical aspects related to long run event studies and the issue which leads to overlapping and cross sectional correlation in returns. The theoretical framework behind the long run event study methodology, autocorrelation and several applicable models of expected performance are further analyzed. Generally event studies serve an important purpose in capital market research as a way of testing market efficiency. Significance tests can be grouped in parametric and non parametric tests (NPTs).

Parametric tests assume that individual firm's abnormal returns are normally distributed, whereas nonparametric tests do not rely on any such assumptions, the selection of the benchmark to use or the model to measure normal returns is therefore central to conduct an event study. The most common approach involves three steps: 1. Compute the parameters in the estimation period 2. Compute the forecast error (and obtain variance / covariance information for a period or over an event window, aggregate across firms and infer about the average effect 3. Regress cross – sectionally abnormal returns on relevant features of the stock supposed to influence the impact of the event.

Event study is a statistical method to assess the impact of an event on the value of a firm; said event may be either typical event (earnings, investment, mergers etc) or economy wide events (inflation, interest rate, consumer confidence etc). The power of analysis which depicts unexpected return presupposes the existence of two basic rules 1. The choice of event, which is able to replicate information to the market, a type of information which has be estimated under common rules and common evaluation criteria. and 2. The choice of an estimator model capable to capture the power of unexpected odds (abnormal returns), which produced due to the event assessment.The observance of two reference rules ensure the power of the test and level of significance of results avoiding committing type I or type II errors

The basic idea of event study that is being examined within the context of present paper is to find the abnormal return attributable to the event being studied by adjusting for the return that stems from the price fluctuation in sectoral level and as a whole market. As event we choice the public research of European Banking Authority regarding to capital adecancy of financial institutions, as assessment which covering more than 70% of total banking assets in the European Union. The framework of

stress test provided competent authorities based on common macroeconomic scenarios, with common set of tools, including a common methodology , an internally consistent but relevant scenarios which display the quality of extination industry in adverse scenario.

Key words: Event Study, Abnormal Returns, Expected Returns, Long Horizon Returns, Bad – Model Problem, Semi strong-form market hypothesis, Chosen techniques, Statistical and Economics models, Cross sectional Correlation, Stress Test, Hypothesis testing, Level of Significance,Overlapping

ΠΕΡΙΛΗΨΗ

Η παρούσα διπλωματική εργασία εστιάζει στην περιγραφή ποικίλων τεχνικής φύσεως απόψεων σχετικά με την μελέτη μακροπρόθεσμης επίδρασης γεγονότων εκτίμησης και το ζήτημα το οποίο οδηγεί στην υπεραπόδοση που δημιουργείται μέσω της απόδοσης των μη αναμενόμενων αποδόσεων. Περαιτέρω, αναλύεται το θεωρητικό πλαίσιο σχετικά με τη μεθοδολογία ανάλυσης μελέτης μακροπρόθεσμης επίδρασης γεγονότων εκτίμησης, αυτοσυσχέτιση και ορισμένα εφαρμοστέα μοντέλα της προσδοκώμενης αντίδρασης.

Σε γενικές γραμμές η αξιολόγηση των γεγονότων εξυπηρετεί σημαντικό σκοπό στην κεφαλαιακή αποτίμηση αγοράς ως μέσο ελέγχου της αποδοτικότητας της αγοράς. Οι έλεγχοι στατιστικής σημαντικότητας μπορούν να διακριθούν σε παραμετρικούς και σε μη παραμετρικούς ελέγχους. Οι παραμετρικοί έλεγχοι υποθέτουν ότι οι μη αναμενόμενες αποδόσεις μιας επιχείρησης διανέμονται κανονικά, ενώ οι μη παραμετρικοί έλεγχοι δεν ερείδονται σε τέτοιες υποθέσεις, επομένως η επιλογή του σημείου αναφοράς που θα χρησιμοποιηθεί ή του μοντέλου που θα μετράει τις αναμενόμενες αποδόσεις είναι κομβικής σημασίας για τη διεξαγωγή της έρευνας.

Η συνήθης προσέγγιση περιλαμβάνει τρία στάδια: 1. Υπολογισμός των παραμέτρων στην περίοδο εκτίμησης, 2. Υπολογισμός του σφάλματος πρόβλεψης (και λήψη πληροφοριών διακύμανσης και συνδιακύμανσης για μία περίοδο ή για το πεδίο εκτίμησης, συνολική εκτίμηση της εταιρείας και συμπέρασμα σχετικά με το μέσο αποτέλεσμα, 3. Μετακύλιση των μη αναμενόμενων αποδόσεων σε σχετικά γνωρίσματα της μετοχής τα οποία υποτίθεται ότι θα επηρεάσουν το αποτέλεσμα του γεγονότος.

Η μελέτη γεγονότος είναι μία στατιστική μέθοδος για την εκτίμηση της επίδρασης ενός γεγονότος στην αξία μιας εταιρείας· αυτό το γεγονός μπορεί να είναι είτε τυπικό γεγονός (κέρδη, επένδυση, συγχωνεύσεις κλπ) ή ευρύτερα οικονομικά γεγονότα (πληθωρισμός, επιτόκιο, καταναλωτική πίστη κλπ). Η βασική ιδέα ενός γεγονότος εκτίμησης που εξετάζεται στο πλαίσιο της παρούσας εργασίας είναι να υπολογιστεί η μη αναμενόμενη απόδοση η οποία οφείλεται στο γεγονός εκτίμησης με την προσαρμογή για την απόδοση η οποία προκύπτει από τον πληθωρισμό τιμών του συνόλου της αγοράς.

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INTRODUCTION

The Science of Economics is frequently asked to measure and quantify the effects that an economic event may imply on the value of the firms. Although it may seem difficult or even unrealistic, a measure methodology can be easily developed by using an event study.

The methodology of event studies is a powerful tool that can help researchers to have access to the financial effect of changes due to a corporate policy. Using this method, the researcher can determine when there is an excessive impact on the share price, in combination with an unexpected economic event. From this definition, the researcher can draw useful conclusions unimportance of the subject event (McWilliams and Siegel, 1997). This method has been used widely in the accounting and finance sector in order to measure the impact of corporate change of control of the company. It has become very popular because it obviates the need for collecting and analyzing accounting data to measure the profitability of a company, and this because many times the accounting data are not good indicators of actual performance of the entity. For example, a manager can handle and manipulate accounting profit in its own volition because they can choose between different accounting procedures (Benston, 1982). From the other side, stock prices cannot be influenced from inside. Stock prices are supposed to reflect the true value of the business, because they reflect the discounted value of all future cash flows and integrate all the relevant information available.

Hence, methodology of event studies, which is based on the change in stock prices, would have to measure the economic consequences that come from changes in corporate policy, leadership or ownership more effectively than a methodology, based primarily to accounting returns. Moreover, the method of studies event is relatively simple to implement, since the only information required is the name of the company, the dates of release of this and equity prices.

The history of event studies started many decades ago. Perhaps the first time published such a survey is that of James Dolley (1933). In his work, examining the effect of splitting the shares (stock splits) in securities prices, taking changes in the nominal values of the shares during the decay period. Using a sample of 95 different

cases from 1921 until 1931 finds that prices rose in 57 cases and decreased in only 26 cases. During the decades from the early 1930s until the late 1960s, the degree of sophistication of the method increased drastically. Examples of the use of the method for this period are the surveys of John H. Myers and Archie Bakay 1948, the C. Austin Barker in 1956, 1957 and 1958 and the end of John Ashley in 1962. At the end of the 1960s the innovative studies Ray Ball and Philip Brown (1968) and the Eugene Fama (1969) gave in the art the form that is until today.

The Ball and Brown took into account the information contained in corporate profitability, while Fama studied the effects of a split of the shares in their prices, after having removed the effects brought about by an increase in dividends. In the following years, they developed various modifications related to the confusion that often result from the misuse of statistical assumptions, which were used in the early years of investigations. Such operations are those of Stephen Brown and Jerold Warner in 1980 and 1985.

Meticulous and thorough research analysis of financial market data within the context of an event study may provide significant conclusions pertaining to the implications of an economic event on the firm value. From a market-oriented point of view, there is no doubt that the main advantage of said study is that it highlights the link between market place and security prices and especially how an event will be immediately reflected in the configuration of security prices. Therefore, a method for the valuation of an economic event may be developed.

In a corporate context, the usefulness of event studies arises from the fact that the magnitude of abnormal performance at the time of an event provides a measure of the impact of this type of event on the wealth of the firms claimholders (S. P. Kothari and Jerold B. Warner, 2006). Accordingly, event studies focusing on long – horizons following an event can provide key evidence on market efficiency (Brown and Warner, 1980, and Fama, 1991).

At the first part of this study there has been a historical review of the research project of event studies focusing on the basic structure underlying the evaluation of an event (basic structure of residual analysis), The purpose of event study (the attempt of the event study) and the procedure to be followed in order to estimate of an event

study. An attempt was made in order to categorization the information which create unexpected returns.

At the second part we proceeded with a basic categorization of the estimator tools which used to evaluate an event, through statistical and economic models.Emphasis has been given on the validity of producing information and how it is channeled into the market, by setting 3 basic hypotheses (Weak form Hypothesis market, Semis strong Hypothesis market and Strong form Hypothesis market), An hypothesis of efficient market has been also defined.

Presented Tools that allow us to appreciate the unexpected returns, moving on categorization by statistical and econometric estimation models. Reflected in two categories events studies with the main feature during their observation period (Short Horizon and Long Horizon Event studies), Presented the main methods of assessment of these categories and the main advantages and disadvantage of them. Emphasis was given on for research option in Long horizon event studies, and specificity resulting less from this research stressing the major challenges that can lead to rejection of the null hypothesis.

At the third part the empirical research is developed by examining the unexpected returns which created through the announcement of the stress tests results; emphasis has been given on the regulatory framework of conducting the stress test and the importance of checking the statistical significance of the results.

We used evaluating methods which led us to the analysis of the results appearing in the work epilogue as presented at the conclusions of present essay.

PART I

CHAPTER 1 : A GENERAL APPROACH

1.1 Nature of Event Study

With the term «event study» we mean the empirical investigation of the relationship between security prices and economic events. Most event studies have focused on the behavior of share prices in order to test whether their stochastic behavior is affected by the disclosure of firm- specific events (Norman Strong, 1992).

Event studies are typically used to assess the economic impact of a given event. The standard procedure is to measure the impact, in terms of the unexpected or abnormal return on the underlying security, by comparing the actual return realized on the occurrence of the event with the expected or normal return, i.e. the return that would have been expected in the absence of the event. Types of event to which the method has been applied include accounting information disclosures, mergers and acquisitions, research and development announcements, and capital, managerial and organizational restructuring. The event study approach assumes capital markets respond efficiently to publicly available news (semi-strong capital market efficiency). On the other hand it circumvents problems of accounting convention and measurement associated with accounting returns (J. Cable and K. Holland, 1999).

During the years two main changes in methodology of estimating returns have taken place. First, the measurements of daily and sometimes intraday rather monthly security return data (Morse 1984 has examined the econometric tradeoff between the choice of monthly and daily data from an analytical perspective, those results are further supported by the simulations studies of Brown and Warner 1980 & 1985 and Dyckman 1984) which allow us to have more accurate estimates of abnormal returns and second the creation of more sophisticated methods which are used to estimate abnormal returns. This second change has enabled to create estimation models which were particularly important for long horizon estimations (over 1 year).

Figure 1

Typical events that belong to the event study category:

Firm - related events which are associated with the entity of a firm such as earning, investment, mergers and acquisitions, issues of new debt or equity, stock splits etc announcements (“Firm Specific events”)
Economy-related events, namely events or special occasions that reflect a general economic situation (of a country or on a wide scale) such as inflation, interest rate, consumer confidence, trade deficient et announcement. Also impacts of announcements in changes of regulatory environments or legal liability cases are events that may affect the firm value “economy wide events”.

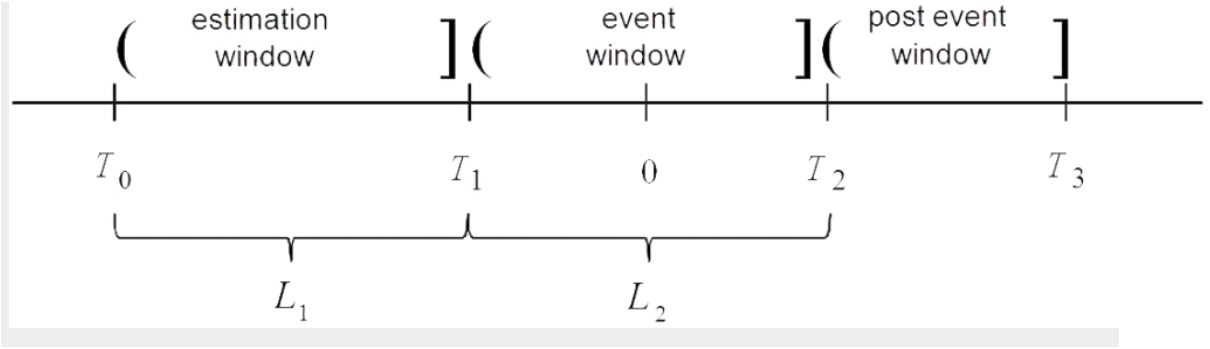
1.2 Procedure to be followed for an event Study

When conducting an event study there are two salient elements that should be determined:

a) Defining the event of interest that will be examined and ,

b) Identifying the period over which the security prices of the firms involved in this event will be examined which called “Event window”.

To be more specific, for example if researcher is looking at the information content of an earnings with daily date. The event will be the earnings announcement and the event window will include the one day of the announcement.



Event Study Metrics applies the common approach by restricting the estimation window (L_1) to the time period prior to the event window (L_2).

Returns will be indexed in event time using τ

Defining,

- $\tau = 0$ as the event date
- $\tau = T_1 + 1$ to $\tau = T_2$ represents the event window
- $\tau = T_0 + 1$ to $\tau = T_1$ constitutes the estimation window.
- Let $L_1 = T_1 - T_0$ and $L_2 = T_2 - T_1$ be the length of the estimation window and the event window respectively.
- the post event window will be from $\tau = T2 + 1$ to $\tau = T3$ and of length $L3 = T3 - T2$.
- the interval $[T_0, T_1]$ is the period of days during which we estimate the values of variables a and b by linear regression of stock returns (R_{it}) with respective returns of the market index (R_{mt}).
- the interval $[T_1, T_2]$ is the event period on which we calculate the average addition return (AAR_t) and cumulative average additional return (Average Cumulative Abnormal Return) $ACAR_t$. For the best study the research results, this period is divided into the period before the event $[T_1, t]$ and the period after the fact [t, T2].

It is customary to define the event window to be larger than the specific period of interest (expanded to multiple days including day before and after the stock market closes on the announcement day). After identifying the event it is necessary to determine the selection criteria for the inclusion of a given firm in the study (Design of the testing framework for the abnormal return).

Appraisal of the event's impact requires a measure of the abnormal return. The return on a firm is correlated to some extent with the return on the market of which it is part, and in the long term at least, riskier shares should earn higher returns.

The abnormal return is the actual ex post return of the security over the event window minus the normal return (expected returns) of the firm over the event window. The normal return is defined as the expected return without conditioning on the event taking place.

$$AR_{it} = R_{it} - E(R_{it} / X_t)$$

AR: Abnormal Return R_{it}; Actual and $E(R_{it} / X_t)$: Normal Return

There are two common choices for modeling the normal return:

A. Constant mean return model which X_t represent the assumption of the constant means return of a given security throw the time

B. Market Model Which X_t represents the market returns which assuming a stable linear relation between the market return and the security return

It is necessary to highlights that the common choice to establish the estimation window is to use the period prior to event window.

1.3 Important Consideration

A. Defining the null hypothesis. The null hypothesis attempts to show that no variation exists between variables, or that a single variable is no different than zero. It is presumed to be true until statistical evidence nullifies it for an alternative hypothesis.

B. Determining the techniques for aggregating the individual firm abnormal return**.** Much of the research involving abnormal returns consists of tests of the efficient markets hypothesis that share prices reflect all available information, so there is no way greater (or less than) normal returns could be earned expect by change.

The presentation of the empirical results follow the formulation of the econometric design especially in studies with a limited number of event observation the empirical results may have been influenced by one or two firms. Choosing to use empirical results will allow to define and understand the source and causes of the effect of the event under study.

Attempt of event study

Event study methodology relies on capturing any abnormal return to a particular security in a given period (U_{jt}), which is simply the difference between actual return (R_{it}) which would have been expected in the absence of the event, and the 'normal' return ($\bar{R}_{it}$) which is defined as the expected value of actual return taken over the probability distribution of (U_{it}). Correct specification of the 'normal' return is critical for the successful application of the method (Strong, 1992).

The goal of estimating an event study is to confirm if the release of accounting information provides information to the market place (Correlation between the observed change of the market value of the company and the information).

Figure 2

Basic Structure of Residual Analysis

1. Identifying event dates for a sample of firms subject to the disclosure item of interest (for example , earnings announcements) and group observations into a common event time
2. Calculating the following (estimate of the) abnormal return for each firm and for each period around the announcement date within the overall test period (TP) of interest.
3. Computing the mean abnormal return across firms in the sample , possibly cumulated over the TP , as an estimate of E($\bar{e}j/yi$) and testing whether E($\bar{e}j/yi$) =0 using a test statistic of the form

$$\frac{mean\ abnormal\ return}{standard\ deviation}$$

1.4 Pieces of Information

Three pieces of information are complied

A. The date of the announcement

B. Actual Earnings

C. Measure of the expected earnings

If earnings announcement convey information to investor it may have impact on the market valuation of the firm equity, thus hypothesis allows to measure the

deviation between prior expectation and actual announcement earnings. It is essential to posit the relation between the information release and the change in value of the equity.

Categorizing the estimates in three groups

A. Good News

B. No News

C. Bad News

The categorization was effected by using as a parameter the deviation between actual and expected score. More specifically, if earnings disclosures carry out information higher than expected will have impact on the value of the firm by increasing the score (earnings) of equity. Contrariwise, if adverse predictions are made the value will decrease.

Consist of prior literature earning – related voluntary disclosures occur infrequently. Good news disclosures tend to be point of range estimates of annual earnings per share (EPS) while bad news disclosures tend to be qualitative statements about the current quarter's earnings (Douglas J Skinner, 1994). The unconditional stock price response to bad news disclosure is larger than the response to good news disclosures quarterly earnings announcements that convey large negative earnings surprises are preempted about 25% of the time be voluntary corporate disclosures while other earnings announcements are preempted less than 10% of the time.

Managers face an asymmetric loss function in choosing their voluntary disclosure policies – managers behave as if they bear large costs when investors are surprised by large negative earnings news, but not when other earnings news is announced.

There are at least two reasons why managers may bear costs as a result of large negative earnings surprises:

A. Stockholders may sue when there are large stock price declines on earnings announcement day since stockholders can allege that managers failed to disclose adverse earnings news promptly (Douglas J Skinner, 1994).

B. Managers may incur reputational cost if they fail to disclose bad news in a timely manner (Douglas J Skinner, 1994).

Money managers, stockholders, security analysts and other investors dislike adverse earnings surprises and may impose costs on firms whose managers are less than candid about potential earning problems

The academic literature has conjectured and documented that firms with negative earnings surprises are more likely to delay their earnings announcements, and those with good news are more likely to report them earlier (Givoly and Dan, 1982; Chambers and Penman, 1984; Bagnoli et al. 2002). The rationale for this managerial behavior is that managers who have negative earnings surprises are more likely to delay the disclosure of negative news, hoping to "soften the blow" by disclosing some positive news at the same time (Joshua Livnat and Li Zhang, 2014), such as a major new customer, a major order, a new strategic partnerships, a positive FDA action, etc.

They also hope that other firms in the industry will report even worse news first, so their own bad news will not cause a strong negative market reaction.

In contrast, when the firm has a positive earnings surprise, it is more likely to rush and disclose it early for several reason:

A. it may upstage similar good news by other firms in the same industry
B. it may set the bar higher for other firms in the industry
C. it may attract analysts' and institutional investors' attention
D. it reduces the likelihood that a negative event will occur (such as a natural disaster, regulatory investigation, revoking its license).

Thus, the timing of the earnings disclosure can potentially show the direction of the earnings surprise. If the timing of the earnings announcement date is a signal of the

subsequent earnings surprise, investors can potentially capitalize on this and earn abnormal returns when they find out the date on which earnings are to be released (Joshua Livnat and Li Zhang , 2014),

By comparing the number of firms that announce earnings early or late based on chronological order, Givoly and Palmon (1982) provide early evidence that bad news seems to be delayed whereas good news earnings are announced earlier. Chambers and Penman (1984) find that the abnormal returns over the actual earnings announcement window are significantly positive for firms that release earnings unexpectedly early (relative to the actual reporting date of the same quarter last year).

PART II

CHAPTER 2 :

2.1 Approach of normal performance

The measurement models of estimating normality return performance can be grouped in two mean categories

2.1.1 Statistical and Economic modeling

2.1.1.1 Statistical model

The statistical model follows the assumption concerning the behavior of asset returns and does not depend on any economics arguments. A statistical model embodies a set of assumptions concerning the generation of the observed data, and similar data from a larger population. A model represents, often in considerably idealized form, the data-generating process. The model assumptions describe a set of probability distributions, some of which are assumed to adequately approximate the distribution from which a particular data set is sampled. A model is usually specified by mathematical equations that relate one or more random variables and possibly other non-random variables. A statistical model is a special type of mathematical model.

What distinguishes a statistical model from other mathematical models is that a statistical model is non-deterministic. Thus, in a statistical model specified via mathematical equations, some of the variables do not have specific values, but instead they have probability distributions; i.e. some of the variables are stochastic

Statistical models are often used even when the physical process being modeled is deterministic. There are three purposes for a statistical model, according to Konishi & Kitagawa 2008.

A. Predictions
B. Extraction of information
C. Description of stochastic structures

2.1.1.2 Economic model

The economic model relies on assumptions concerning investors' behavior that are not based solely on statistical assumptions. However it is important to observe statistic analysis. In economics,, a model is a theoretical construct representing economic processe by a set of variables and a set of logical and/or quantitative relationships between them. The economic model is a simplified framework designed to illustrate complex processes, often but not always using mathematical techniques. Frequently, economic models posit structural parameters. Structural parameters are underlying parameters in a model or class of models. A model may have various parameters and those parameters may change to create various properties. Methodological uses of models include investigation, theorizing, and fitting theories to the world.

In general terms, economic models have two functions: first as a simplification of an abstraction from observed data and second as a means of selection of data based on a paradigm of econometric study.

Given the enormous complexity of economic processes, simplification is particularly important for economics. This complexity can be attributed to the diversity of factors that determine economic activity; these factors include: individual and cooperative decision processes, resource limitations, environmental and geographical constraints, institutional and legal requirements and purely random fluctuations. Economists therefore must make a reasoned choice of which variables and which relationships between these variables are relevant and which ways of analyzing and presenting this information are useful.

Selection is important because the nature of an economic model will often determine what facts will be examined, and how they will be compiled. For example inflation is a general economic concept, but to measure inflation requires a model of behavior, so that an economist can differentiate between real changes in price, and changes in price that are to be attributed to inflation.

2.2 Types of Economics Models

There are four types of models used in economic analysis (Gary R. Evans, 1997)

2.2.1.Visual Models

Visual models are simply pictures of abstract economy graphs with lines and curves that tell an economic story. They are primarily used in textbooks and teaching, and the reader who hasn't had any exposure to economics at all has probably seen dozens, if not hundreds of them.

Some visual models are merely diagrammatic, such as those which show the flow of income through the economy from one sector to another. In other words, they employ a visual device to present a very general economic concept. Most visual models, though, are visual extensions of mathematical models. Implicit in their structure is an underlying mathematical model. The models do not normally require any knowledge of mathematics, but still allow the presentation of complex relationships between economic variables. These models are relatively easy to understand, but are somewhat limited in their scope. In other words, sometimes it's so easy and simple to draw conclusions from visual models that mathematics is not used as an explanation tool.

2.2.2 Mathematical Models

The most formal and abstract economic models are the purely mathematical models. These are systems of simultaneous equations with an equal or greater number of economic variables. Some of these models can be quite large. Even the smallest will have five or six equations and as many unknown variables. The manipulation and use of these models require a good knowledge of algebra or calculus.

The variables in a model like this represent a type of economic activity (such as demand) or data (information) that either determines or is determined by that activity (such as a price or interest rate). Variables can usually be classified as endogenous or exogenous. An endogenous variable is one that is determined within the model, or by

the model's solution. Its value becomes known when the model is solved. On the other hand, if the value of a variable is preset and is not determined within the model, it is regarded as an exogenous variable.

2.2.3 Empirical Models

Empirical models are mathematical models designed to use only quantitative data. The fundamental version of the model is the mathematical model, exactly as described above. By using the empirical model, however, data is gathered for the variables, and using accepted statistical techniques, the data are used to provide estimates of the model's values.

2.2.4 Simulation Models

Simulation models, which can be used only with computers, embody the very best features of mathematical models without requiring the user to be proficient in mathematics. The computerized simulation model can show the interaction of numerous variables all at once, including hidden feedback and secondary effects that are not so apparent in purely mathematical or visual models. With such simulations, the careful user, especially if guided by a good text or instructor, can reason through the complicated chains of influence without necessarily understanding the underlying mathematics.

Figure 3

Main advantages of Economics and Statistical models

The advantage of economic assumption is an opportunity which gives in order to calculate more precise measures of the normal return
Statistical model implies the assumption that asset returns are jointly multivariate normal and independently and identically distributed through time. This distributional assumption is sufficient for the constant mean return model and the market model to be correctly specified. In practice it generally does not lead to problems because the assumption is empirically reasonable and inferences using the normal return models tend to be robust to deviations from the assumption.

2.3 Forms of efficient markets

In 1978 Jensen determined the market's efficacy stating that a market is effective in relation with an information, if this information may be used in order to gain economic profit. According to Malkiel (1992) a capital market is efficient when it fully and correctly reflets all the information related to the definition of the securities prices. Pursuant to another widely used definition a market is efficient when the securities prices are quickly adapted to the announcement of new information; consequently current securities prices fully reflect all available information regarding securities. Main representative of efficient market hypothesis is Fama who tried to standardize theory and to organize the constantly developing empirical research.

In order to define efficient market it is necessary to refer to the 3 basic categories governing the power of the info being channeled into the market. The analysis and evaluation of the reproduced results from a market-oriented perspective, as well as the effect of these, require accepting assumptions regarding the way of information channeling.

It is important to assume that the information is transferred in a way that is recognized, accepted and assessable with the same rules by everyone. The investors should be confident that the market prices fully reflect all the available information and thus the expected performance which is based on these prices is linked to the risk. According to Fama, the three key categories of cases and their salient features are elaborated below.

2.3.1 A. Weak-form Hypothesis market

This form assumes that the current share prices are adapted to all the information of the past including historical prices, yields and the volume of purchases and sales. Because of assumption that current prices already reflect all past performance and any other information in the past, this efficient market form finds it impossible to complete super profits using only information in the past, and that it applies the random walk hypothesis, which accepts that the changes in securities prices occur in a manner unspecified - random. The theory of random walk, as developed in economics, holds that the future course of the price of a share is no more predictable than the course of a cumulative series of random numbers. In statistical terms, this theory states that successive price changes are independent and identical distributed random variables. In simpler performance, we can say that the time series of price changes has no memory, which means that the past cannot be used to predict the future.

According to Fama, if one accepts the hypothesis of efficient low power market force, and therefore the random walk in shaping asset prices, they are forced de facto to reject the validity of the theories that support the technical analysis because not allowing past values gives us a secure position for the future course of prices, however interesting it may be the course of the past that we are investigating.

Therefore, the random walk and technical analysis are two theories that cannot coexist. The hypothesis of random walk itself comprises of two separate cases: a) the assumption that successive price changes are independent of each other, and b) that the price changes are adjusted in a probability distribution.

Fama explains the independence of price changes, indicates that the distribution of the probability of the price change during a period of time is independent of the number of price changes during previous periods. So the knowledge of price changes range which lead to the period we are considering, it helps to determine the distribution of price changes probability of the period under examination. Although it is quite difficult to find a time series of price changes which is characterized by perfect independence, for practical reasons, we accept the hypothesis of the model independence that look, provided that the dependence of price changes does not exceed a minimum acceptable limit. This minimally acceptable limit depends on the problem which everyone is called upon to solve. In the view of Fama, the independence of which is important from the view of an investor does not mean that it is important and from consideration of a statistical analyst, and vice versa. More specifically, if we know that on different days, the price of a security is always increased by a percentage and then reduced by the same percentage, from a statistical point of view that knowledge of the price dependence would be quite important since it informs us about the shape of distribution of price changes. However, with regard to investment, whether this percentage change what price is low, then the knowledge of this dependency is meaningless because any profits you derive an investor, will evaporate from the existence of transaction costs.

Consistency independence presence changes what prices are, in principle, that once they reach the market this independence, technical analysis can no longer be considered a profitable activity. At a time series of mutually independent price changes, knowledge of the past can not be used as a lever to increase the expected profits. On the other hand, in a dynamic economic environment, the arrival of new information constantly pushes the intrinsic value of the securities in a constant change. The result of this change is that investors who can consistently predict the arrival of new information and evaluate their impact on the intrinsic value of the shares, will be able to achieve higher rates of return than other investors who have no such talent.

With respect to the adjustment of price changes in a probability distribution, from the perspective of investors, the identification of this distribution is very important. The form of distribution greatly helps in determining the level of risk in investing common shares. For example, although two different probability distributions can have the same mean value, one can show greater variability (fluctuation) on the other. The form of sharing of our price changes also provides important information about the process of creating these changes, while an important tool for anyone wishing to conduct empirical research on change in securities.

2.3.2 B. Semi strong-form hypothesis market

This hypothesis contends that securities prices adjust rapidly all new information diffused to the market, which means that the current prices of securities reflect all available information. to the public. Generally we can say that the assumptions of median power include the assumption of lower power because all information of the past is considered to be publicly available Such information we can include and notices concerning the profitability and dividend mood, all financial indicators such as the price-earnings ratio per share (price-to-earnings ratio), the dividend yield ratio (dividend- yield ratio), the market index to a nominal value (price-to-book-value), as well as information regarding the split of shares, economic and political news. This case average power implies that investors who base their investment decisions on any significant new information after the disclosure of the public will not be able to achieve returns above the average, conducting transactions. That is, super-profits can not be made after the arrival of information.

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2.3.3 C. Strong-form hypothesis market

According to the hypothesis of strong market entry securities prices fully reflect all information, both publicly available and unavailable. This simply means that no group of investors may not take advantage from information they do not know while other investors. Therefore there is no information to remain private, but all the information is disclosed to investors. So, no investor can not systematically achieve returns higher than the average, as adjusted according to risk. The effective power market surrounds so this low, and average power and further goes one step further than the case of price rapid adaptation to new information, implying that markets work perfectly, since all the information is available to all the same time and at no cost.

Figure 4

Hypotheses of efficient markets' existence

The concept of effectiveness of the operation on financial markets is based on three key assumptions, which need to be simultaneously in force:

A. The primary assumption underlying the idea of efficient markets is the existence of a large number of investors who are trying to maximize their profits and thus they analyze and evaluate the securities each of them individually and independently from the other

B. The second assumption is that the new information coming to market randomly and generally the information is independent one from one another. This means that there is no way to predict the new information before they appear in the market, and therefore they have no effect on the security price up to the time of their announcement.

C. The investors with investment decisions they make in their effort to maximize profits, eventually push the securities prices to quickly adapt to new information

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CHAPTER 3: Models for returns' evaluation

3.1 Measurement Abnormal Return

The basic intuition of event studies is the comparison of the return of an event firm with the return of a corresponding benchmark, over the same period of time. A common way to assess the expected (benchmark) return is to apply an asset pricing model.

All models of expected performance are subject to a joint hypothesis test (Fama, 1998) that:

A. The market is efficient
B. The model is able to measure the variation of expected returns.

Assuming semi strong market efficiency, any delay in the response of new information is possible only for a few days. Hence, the magnitude of model misspecification will be small when measuring a few days AR. In fact, evidence suggests that few day AR are qualitatively similar as applying more complicated or sophisticated models (Fama 1998; Kothari and Warner 2007).

The measured returns can be classified into two categories: discrete or logarithmic. Strong (1992) advocates that logarithmic returns should be preferable over discrete ones for theoretical and empirical reasons.

Discrete returns can take on only a finite (or countably infinite) number of values and logarithmic returns can take on any value in some interval of values

Discrete and Logarithmic

Discrete: $R_{it} = \frac{Pit+Dit-Pit-1}{Pit-1}$

Logarithmic : $R_{it} = \log [(P_{it}+D_{it}) / P_{it-1}]$

Where,

P_{it} = the price of security i at the end of period t

D_{it} = dividends paid during period t

P_{it-1}= the price of security i at the end of period t-1 adjusted for any capitalizations in order to make it comparable to Pit

In theory, logarithmic returns are analytically more tractable when linking together sub-period returns to form returns over longer intervals. In practice they are more likely to be normally distributed and so conform to the assumptions of standard statistical techniques (Dionysiou, 2015).

3.1.1 Models of measuring Abnormal Returns

The choice of a model capable to capture the reproduced unexpected returns which are linked to a fact, is considered of high importance and is directly related to the quality of the results of the research. The control of the power and statistical significance of the findings, the connection of the findings with the kind of information are key priorities of the researcher.

The main models for the estimation of market performance as well as their features and characteristics are presented below.

3.1.1.1 Index model

$$AR_{it}=R_{it} - R_{mt}$$

The Index Model is perhaps the simplest model (Lakonishok and Vermaelen , 1990). We assume that over any period t, a share i will earn the market rate of return R_{mt} (over a specific period of time $E(R_{it})=R_{mt}$).Then the abnormal return AR_{it} is the actual return R_{it} , less R_{mt}.

3.1.1.2 Average return model

$$AR_{it}=R_{it} - \bar{R}_i$$

Another simple model is to assume that the share earns the same return as it does on average during an estimation period before or around the test period where $\bar{R}_i$ is the average return of the share during the estimation period.

3.1.1.3 Constant Mean Return Model

This model assumes that an asset's return over time is independent and identically normally distributed with a constant (time invariant) mean and variance. The model allows for the returns on different assets to be contemporaneously correlated but that the correlations are constant over time. Model has a very simple form and is identical to the measurement error model in the statistics literature. As per this model each asset return is equal to a constant (the expected return) plus a normally distributed random variable with mean zero and constant variance. The random variable can be interpreted as representing the unexpected news concerning the value of the asset that arrives between time t−1 and time t.

$$R_{it} = \mu_{it} + \varepsilon_{it}$$

$$E(\varepsilon_{it}) = 0 \quad var(\varepsilon_{it}) = \sigma^2 \varepsilon_{it} .$$

Where $R_{it\ symbolize}$ the period t return of security i, μ_{it} the mean return of asset i and ε_{it} the disturbance term for security i (Brown and Warner, 1980, 1985). If the news between times $t - 1$ and t is good, then the realized value of ε_{it} is positive and the observed return is above its expected value μ_{it}. If the news is bad, then ε_{it} is negative and the observed return is less than expected. The assumption $E(\varepsilon_{it}) = 0$ means that news, on average, is neutral neither good nor bad. The assumption that $var(\varepsilon_{it}) = \sigma^2 \varepsilon_{it}$ can be interpreted as saying that volatility, or typical magnitude, of news arrival is constant over time.

The random news variable affecting asset i, ε_{it} is allowed to be simultaneously correlated with the random news variable affecting asset j, ε_{jt} to capture the idea that news about one asset may spill over and affect another asset. Good news should lead to positive values of both ε_{it} and ε_{jt}. Hence these variables will be positively correlated due to a positive reaction to a common news component

Although this model is very simple, it provides important intuition about the statistical behavior of asset returns and prices and serves as a benchmark against which more complicated models can be compared and evaluated.

The disadvantage of constant mean return model is the fact that the variance of the abnormal return is frequently not reduced (Lack of sensitivity to the model). More sophisticated model is preferred.

3.1.1.4 Market Model

The Market Model is a statistical model which relates the return of any given security of the return of the market portfolio. It is necessary to hypothesis normality of asset returns.

$$R_{it} = \alpha_i + \beta_i R_{mi} + \varepsilon\ it \quad E(\varepsilon_{it}) = 0,$$

$$Cov(R_{mt},\varepsilon_{it})=0 \text{ , var } (\varepsilon_{it}) = \sigma^2_{it}$$

Variation of abnormal return is constant throw the time

Where R_{it} and R_{mt} symbolize the period t returns a security i and the market portfolio. E it is the zero mean disturbance term. α_i β_i and σ^2 the parameters of the market portfolio. Having calculated estimates of α_i and βi with data from an estimation period, the expected return is given by inserting the estimated values of α_i and β_i together with the actual return on the market.

Thus,

$$AR_{it} = R_{it}-(\alpha_i+\beta_i R_{mt}).$$

Market model abnormal returns are prediction errors if the test period is distinct from the estimation period, in which case the abnormal returns are given by the relevant subset of regression error terms.

The market model represents a potential improvement over the constant mean return model. By using constant mean return model actually we remove the portion of the return that is related to variant in the markets return with impact to the variance of the abnormal return (reduced).

Further motivation for employing the market model is that, in generally it results in smaller variance of abnormal returns (relative to raw returns), leading to more powerful statistical tests and that it produces smaller correlations across security abnormal returns giving closer conformity to standard statistical test (Beaver 1981)

The benefits arising from the use of the market model will depend upon the R^2 of the market model regression (Lower R^2 lids to greater variance of the abnormal return). This in turn can lead to increase ability to detect event effects.

$$R^2 = \left(\frac{cov(Ri, Rm}{\sigma i * \sigma m}\right)^2$$

R^2 represent the explaining basis of percentage volatility of share price performance by the variability index performance. In literature other statistical models have been proposed for modeling the normal returns. They attempt to reduce the variance of the abnormal return by explaining more of the variation in the normal return. This is called factor models. The market model is an example of a one-factor model (observe traded security).

3.2 Control Portfolio model

In the control portfolio model the returns of a test portfolio are compared with those of a control portfolio designed to have the same pre event risk characteristics with the event firms measured by beta. Abnormal returns are measured by subtracting control portfolio returns from those of the test portfolio during the test period.

It is well known that ex post betas do not explain much of the difference between actual returns on shares or portfolios, Fama and French (1992) find that the relation between β and average returns on stocks for 1993 -1990 is feeble, even when β is the only explanatory variable (Fama 1991, p.1592). It is worth noting that the use of constructed portfolio does to directly examine the market efficiency hypothesis instead it examines whether known patterns are captured by both event and benchmark, samples (Loughran and Ritter, 2000).

As ti will be further analyzed the selection of a control portfolio as reference point (benchmark) in surveys conducted to evaluate performance, particularly in techniques like Buy and Hold, constitutes a key element of the empirical study.

The expected performance of an asset should be reflected as a reference point (benchmark); this performance should be representative of the sample under evaluation and permits the comparison between the effected performance and the unexpected performance. The rational choice ensures the effect of findings and the

avoidance of estimation mistakes. It is important to note that using as benchmark the control portfolio in fact the performance is reflected at sector level rather than at market level. The unexpected performance resulted from an event is quantified through this process allowing the measurement of event impact.

The contol portfolio must contain shares with same characteristics and sensitivities with the asset under evaluation, having also the same sensitivity to the performance and recognizable retention risk; all these elements are basic prerequisites to ensure the performance evaluation at sector level.

In other words, with reference to the performance of a group of shares with the same features as the estimated asset manage to maintain an acceptable comparative evaluation with the effected performance against her that would be without the presence of disturbance yields suddenly events. Besides the choice of the benchmark, including its structure, should reflect the expected performace in case of no occurrence of the event.

In the empirical research conducted within the context of this paper the benchmark used has been the performance of financial institutions which have not been influenced by the announcement of stress tests results and thus they have maintained the same risk and performance level recognized by the market (capital adequacy at the announcement date).

It is important to note that through control portfolio we are actually given the chance to isolate an event at sector level, in other words to evaluate the information at the level of unexpected performance by isolating the turbulence diffused into the market and is not representative.

Using a control sample from the same industry should drastically reduce the bad model problem because, under the null hypothesis of no abnormal returns ,

average returns for event firms should not be different from returns for the reference portfolios (Giambona, Carmelo& Sirmans, 2005 p.363)

3.3 Main multi- factor evaluation models

There are evaluation models including factors which aim to appear more specialized performances, so as to achieve a high grade of representative performances.

The main multi- factor evaluating models are presented below:

3.3.1 Fama - French 3 factor model.

In asset pricing and portfolio management the Fama- French three factor model is a model designed by Eurene Fama and Kenneth French to describe stock returns.

The traditional asset pricing model (CAPM) uses only one variable to describe the returns of a portfolio or stock with the return of the market as a whole. The Fama-French 3 factor model is an extension of the market model to the tune of two additional factors to explain security/portfolio returns:

A. The size premium
B. Book - to - market (value) premium.

The model was developed in response to prior research and empirical observations that indicated systematic outperformance of small firm / value stocks versus large firm / growth stocks and the market as a whole. It is clear that variation in size produces a variation in average returns that is positively related to variation in market betas, the central risk-return relation posited by the CAPM. By contrast,

variation in the book-to-market ratio produces a variation in average returns that is negatively aligned to variation in market betas, violating the central implication of risk-return models.

Fama and French started with the observation that two classes of shares have tended to do better than the market as a whole:

A. Small caps
B. Stocks with a low price to Book Ratio.

$$R_{i,t} - R_{f,t} = a_i + b_j(R_{m,t} - R_{f,t}) + s_i SMB_t + h_i HML_t + e_{i,t}$$

In this equation R_{it} is the return on security or portfolio i for period t, R_{ft} is the risk free return, R_{mt} is the return on the value-weight (VW) market portfolio,

SMB_t calculated as the difference between the returns on a diversified portfolio of small stocks minus the return on a diversified portfolio of big stocks. It is the premium on the size portfolio (market capitalization) which distinguishes the market securities into small and big capitalization.

HML_t is the difference between the average returns on diversified portfolios of high and low book to market stocks, Is the premium on the growth portfolio distinguishing the market securities into high and low growth (Book to Market) and e_{it} is a zero-mean residual.

Moreover once SMB and HML are defined, the corresponding coefficients s_j and h_j are determined by linear regression and may take negative values as well as positive values. The three-factor model b is analogous to the classical b but not equal to it, since there are now two additional factors.

3.3.2 Four-Factor Model

The four-factor model extends the Capital Asset Pricing Model [CAPM] with three additional factors: the Fama-French size and book-to market (BTM) factors and the Carhart (1997) momentum factor also known in the industry as the MOM factor (monthly momentum).

The inclusion of this fourth factor is a response to studies that showed how stocks with strong past performance continue to outperform stocks with poor performance in the next period gathering an average excess return of 1% per month (Jegadeesh & Titman, 1993). Momentum in a stock is described as the tendency for the stock price to continue rising if it is going up and to continue declining if it is going down.

The MOM can be calculated by subtracting the equal weighted average of the highest performing firms from the equal weighed average of the lowest performing firms, lagged one month (Carhart, 1997).

$$R_{it} - Rft = a_i + bi(R_{mt}-R_{ft}) + s_iSMB_t + h_iHML_t + p_iPR1YR_t + e_{it}$$

In this equation $PR1YR_t$ is the average return of firms with the highest 30% 11 month returns (lagged 1 month) minus the average return of firms with the lowest 30% 11 month return (lagged 1 month).

As a performance attribution model, the four-factor model captures the risk and return characteristics of four elementary equity investment strategies:

A. Investing in high versus low market sensitivity stocks
B. Investing in small versus large market capitalization stocks
C. Investing in value versus growth stocks
D. Investing in momentum versus contrarian stocks

Four Factor model documents low cross correlation which implies that multicollinearity does not substantially affect the estimated formula

Figure 5

Equally Weighted Index

An equally weighted index weights each stock equally regardless of its market capitalization or economic size (sales, earnings, book value). Due to daily price movements of the stocks within the index, the portfolio must be constantly re-balanced to keep the positions in each stock equal to each other

Advantages	Disadvantages
The index is highly diversified with all stocks in the universe equally weighted.	No distinction is made between the relative or absolute valuation of stocks within the universe
As opposed to market cap weighting, the index does not overweight overpriced stocks and underweight underpriced stocks. Pricing errors are random.	Difficult to keep the stocks in the index equally weighted due to constant price fluctuations.
Easy to construct relatively tax efficient ETFs and mutual funds.	Difficult for this type of index to manage substantial amounts of money due to the need to invest equal amounts in both the largest and smallest stocks.
Usually adds 1 – 2 percent in annual return over long periods after expenses vs. market cap weighted indexes.	

Value Weighted Index Portfolios

A Value Weighted Index weights stocks within the relevant universe based on a calculation of each stock's absolute and relative value as compared to the other stocks within the index universe. The index is continually rebalanced to weight most heavily those stocks that are priced at the largest discount to various measures of value. The index is updated as prices and company fundamentals change.

Other multifactor models include industry indexes in addition to the market (William Sharpe, 1970, Cordon Alexander and Jeffery Bailey, 1995) provide discussion of index models with factor based on industry classification.

Another variant of a factor model is a procedure which calculates the abnormal return by taking the difference between the actual return and a portfolio of firms of similar size (size is measured by market value of equity). The hypothesis of this kind of test is that expected return is directly related to market value of equity.

Generally the gains from employing multifactor models for event studies are limited. The reason for the limited gains is the empirical fact that the marginal explanatory power of additional factors of additional factors the market factor is small and hence.

When we observe sample firm with common characteristic the variance reduction will typically be greater; for example if they are all members of one industry or they are all firms concentrated in one market capitalization group. In these cases we prefer to use of a multifactor model warrants consideration.

Other model is dictated by data availability. An example of a normal performance return model implemented in situation with limited date is the market adjusted return model.

The market adjusted return model can be viewed as a restricted market model with α_i constrained to be zero and β_i constrained to be one. An example of such model is used in event study Jay Ritter 1991. A general recommendation would be to use such restricted models only if necessary.

Summary Models of measuring Abnormal Returns

Models	Formula	
Index model	$AR_{it} = R_{it} - R_{mt}$	AR_{it}:Abnormal Return, R_{it}:Actual Return,
Average return model	$AR_{it} = R_{it} - \bar{R}_i$	AR_{it}: Abnormal Return, R_{it}:Actual Return,$\bar{R}_i$:Average Return of the share during the estimation period
Market model	$AR_{it} = R_{it}-(\alpha_i+\beta_i R_{mt})$	$\beta i=Cov(R_{it},R_{mt})/Var(R_{mt})$, measure of the risk arising from exposure to general market movements , αi=is the intercept
FF 3 factor model	$Rit - R_{ft}=a_i + b_i(R_{mt}-R_{ft})+ siSMBt + hiHMLt + eit$	SMBt is the return on a diversified portfolio of small stocks minus the return on a diversified portfolio of big stocks, HMLt is the difference between the returns on diversified portfolios of high and low B/M stocks, and eit is a zero-mean residual, Rft: risk free return
Four-factor model	$Rit - Rft = ai + bi(Rmt-Rft) + siSMBt + hiHMLt + piPR1YRt + eit$	PR1YRt (Momentum factor): is the average return of firms with the highest 30% 11 month returns (lagged 1 month) minus the average return of firms with the lowest 30% 11 month return (lagged 1 month)

In the control portfolio model the returns of a test portfolio are compared with those of a control portfolio designed to have the same risk, measured by beta. Abnormal returns are measured by subtracting control portfolio returns from those of the test portfolio during the test period.

3.4 Estimating Economics Models

Economic models may be regarded as restriction on the statistical models to provide more constrained normal return models.

Three common economic models which provide restrictions are:

A. Capital Asset Pricing Model (CAPM)

B. Multi-factor Capital Asset Pricing Model

C. Arbitrage Pricing Theory (APT)

3.4.1 Capital asset pricing model (CAPM)

The CAPM was introduced by Jack Treynor (161,1962), William F. Sharpe (1964), John Lintner91965a,b) and Jan Mossin (1966) independently, building on the earlier wok of Harry Markowitz on diversification and modern portfolio theory.

Due to Sharpe (1964) and John Lintner (1955) CAPM is an equilibrium theory where the expected return of a given asset is determined by its covariance with the market portfolio. Studies of the performance of managed funds commonly use the CAPM as a benchmark measuring returns of estimating portfolio.

CAPM is a measure model which use economic theory that attempts to provide a relationship between risk and returns, or equivalently, it are a model for the pricing of risky securities. The CAPM assets that the only relevant risk that investors will require compensation for assuming is systematic risk because that risk cannot be eliminated by diversification.

The expected return of a security or a portfolio is equal to the rate on a risk free security plus a risk premium. The risk premium is proportional to the security or the portfolio beta. More specifically, the risk premium is the product of the quantity of

risk and the market price of risk , measured by beta , and the difference between the expected market return and risk free rate, respectively.

The general idea behind CAPM is that investors need to be compensated in two ways: time value of money . The time value of money is represented by the risk-free (rf) rate in the formula and compensates the investors for placing money in any investment over a period of time. The other half of the formula represents risk and calculates the amount of compensation the investor needs for taking on additional risk.

The model is,

$$E(R_{it})=R_{ft}+\beta_i[E(R_{mt})-R_{ft}]$$

where ,

- $E(R_{it})$: is the expected or normal return on share i for time t
- R_{ft} : is some measure of the risk free rate of interest
- $E(R_{mt})$: is some measure of the expected return on the appropriate stock market
- β_i : is the covariance of R_{it} with R_{mt} over some estimation period divided by the variance of R_{mt} over that period

$$\beta_i = \frac{(\text{cov}(\text{Rit},\text{Rmt}))}{(\sigma 2(\text{Rmt}))}$$

The theory is that ex ante expected values of R_{mt} and β_{it} determine $E(R_{it})$, but ex post values are usually substituted as proxies. Beta is the models measure of the risk of the share. The abnormal return on share i for time t is estimated by subtracting the actual return, Ri , from the expected return $E(R_{it})$.

The CAPM assumes that investors are concerned with only one risk: the risk having to do with the future price of a security. However, there are other risks, such as the capacity of investor to consumer goods and services in the future.

Figure 6

Drawbacks and Advantages of CAPM estimating model

Drawbacks

Risk-free Rate (R_f): The commonly accepted rate used as the R_f is the yield on short term government securities The issue with using this input is that the yield changes daily, creating volatility

Return on the Market (R_m): The return on the market can be described as the sum of the capital gains and dividends for the market. A problem arises when at any given time, the market return can be negative. As a result, a long-term market return is utilized to smooth the return. Another issue is that these returns are backward-looking and may not be representative of future market returns.

Ability to Borrow at a Risk-free Rate: CAPM is built on four major assumptions, including one that reflects an unrealistic real-world picture. This assumption, that investors can borrow and lend at a risk-free rate, is unattainable in reality. Individual investors are unable to borrow (or lend) at the rate the US government can borrow at. Therefore, the minimum required return line might actually be less steep (provide a lower return) than the model calculates.

Determination of Project Proxy Beta: Businesses that use CAPM to assess an investment need to find a beta reflective to the project or investment. Often a proxy beta is necessary. However, accurately determining one to properly assess the project is difficult and can affect the reliability of the outcome.

Unfortunately deviations from the CAPM have been discovered (The use of CAPM is common in event studies of the 1970) implying that the validity of the restrictions is questionable (Eugene Fama and Kenneth French 1996 provide discussion of these anomalies). Sensitivity of CAPM restrictions.

Advantages

Ease-of-use: CAPM is a simplistic calculation that can be easily stress-tested to derive a range of possible outcomes to provide confidence around the required rates of return.

Diversified Portfolio: The assumption that investors hold a diversified portfolio, similar to the market portfolio, eliminates unsystematic (specific) risk.

Systematic Risk (beta): CAPM takes into account systematic risk, which is left out of other return models, such as the dividend discount model (DDM). Systematic or market risk is an important variable because it is unforeseen and often cannot be completely mitigated because it is often not fully expected.

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3.4.2 Multi-factor Capital Asset Pricing Model

Multifactor pricing models was introduced by Ross (1976) through the Arbitrage Pricing Theory and by Merton (1973) through the Intertemporal CAPM. The multifactor pricing model implies that the expected return on an asset is a linear function of factor risk premiums and their associated factor sensitivities

The multifactor CAPM assumes investor face such extra market sources of risk called factors. The expected return in the multi factor CAPM is the market risk, as in the case of the basic CAPM, plus a package of risk premiums. Each risk premium is the product of the beta of the security or portfolio with respect to the particular factor and the difference between the expected return for the factor and the risk free rate.

Multifactor CAPM form:

$$E(r_p)=b_{pm}E(r_m)+bp_{F1}E(r_{f1})+bp_{F2}(E(r_{F2})+\ldots.+bp_{FK}E(r_{FK})$$

Where,

- k: is the number of factors or extra market sources of risk (have a systematic effect on the returns of each security)
- bp_{Fk} : is the sensitivity of the portfolio to the k_{th} factor
- $E(r_{FK})$: is the expected return of factor k minus the risk free rate

Multifactor CAPM model includes elements of capital asset pricing model and macroeconomics skills which called factors. Proponents claim that the multifactor CAPM better accounts for systemic risks and fits data better, while critics contend that the model does not calculate the relative riskness of each factor compared to other factors.

In their research Johan Ericsson and Sune Karlsson, 2004 mentioned "Using different portfolios as the investment universe we find strong evidence that a general multifactor pricing model should include the market excess return, the size premium, and the value premium. The evidence in favor of the momentum factor is more sensitive to the sample used and the prior specification. In addition, we find evidence that the credit risk spread should be included as an additional factor".

Figure 7

Main Characteristics of Multi-factor Models

Multi-factor models are used to construct portfolios with certain characteristics, such as risk, or to track indexes. When constructing a multi-factor model, it is difficult to decide how many and which factors to include. One example, the Fama and French model, has three factors: size of firms, book to market values and excess return on the market. Also, models will be judged on historical numbers, which might not accurately predict future values.

Multi-factor models can be divided into three categories: macroeconomic, fundamental and statistical models. Macroeconomic models compare a security's return to such factors as employment, inflation and interest. Fundamental models analyze the relationship between a security's return and its underlying financials (such as earnings). Statistical models are used to compare the returns of different securities based on the statistical performance of each security in and of itself.

Using multifactor normal performance models motivated by Arbitrage Pricing Theory demonstrated that with APT the most important factor behaves like a market factor and additional factors add relatively little explanatory power so the gains from using this techniques are small (Stephen Brown and Mark Weinstein 1982)

The advantage from using a model based on the arbitrage pricing theory is to eliminate the biases introduced by using the CAPM

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3.4.3 Arbitrage Pricing Theory (APT)

Arbitrage Pricing Theory (APT) was developed by Stephen Ross 1976 and is based purely on arbitrage arguments. Is postulate that the expected return on a security or a portfolio is influenced by several factors. Proponents of model were one period model in which every investor believes that the stochastic properties of returns of capital assets are consistent with a factor structure.

In finance , arbitrage pricing theory (APT) is a general theory of asset pricing who argue that the expected return of a financial asset can be modeled as a linear function of various macro-economic factors or theoretical market indices, where sensitivity to changes in each factor is represented by a factor-specific beta coefficient.

The model-derived rate of return will then be used to price the asset correctly, the asset price should equal the expected end of period price discounted at the rate implied by the model. If the price diverges, arbitrage should bring it back into line is an asset pricing theory where the expected return of a given asset is a linear combination of multiple risk factor.

Risky asset returns are said to follow a factor intensity structure if they can be expressed as :

$$r_i = \alpha_i + b_{i1}F_1 + b_{i2}F_2 + \ldots\ldots + b_{in}F_n + \varepsilon_{i.}$$

$$E(\varepsilon i)=0$$

Where

- α_i is constant for asset i
- F_k is a systematic factor
- b_{ik} is the sensitivity of the i_{th} asset to factor k also called factor loading
- ε_i is the risky assets idiosyncratic random shock

The APT states that if asset returns follow a factor structure then the following relation exists between expected returns and the factors sensitivities was :

$$E(r_i) = r_f + b_{i1}RP_i + b_{i2}RP_2 + \ldots. + b_{in}RP_n$$

Where,

- RP_k is the risk premium of the factor
- r_f is the risk free rate.

The expected return of an asset i is a linear function of the assets sensitivities to the n factors.

3.5 Bad – Model Problem

Asset pricing model have systematic problems in explaining the average (expected) returns, mainly for small firms with low BTM . The models predict strong growth for low BTM stocks and poor growth for high BTM stocks. This bad model problem is observable in all methods estimating AR that use size and BTM as risk factors.

$$\text{Book to Market ratio (BTM)} = \frac{Book\ Value}{Market\ Value}$$

The book value of a company is determined by looking at a company's balance sheet, and equals the value of the assets over the company's liabilities. Divide the book value by the market value to get the book-to-market ratio. If the ratio of BTM is below one, the company's stock is considered overvalued. Conversely, if the ratio is greater than one, then the company's stock is considered undervalued.

These raise a question whether the AR derive from the tested corporate event, misspecifications of the pricing model, or combine effects of the event and model misspecifications. If a model cannot properly capture the cross section variation of expected returns, a long horizon event study would be misspecified. Thus, the estimated AR would miss leading and could not be used to draw conclusions related to the event. Similarly, if the market does not understand that return growth tends to mean revert, stock prices at the event time would be too high by definition. If the market realizes its mistake gradually, prices and returns will reverse. According to

Fama (1998) it is likely that no method can minimize the bad model problems for all classes of events, while all long run event study approaches are incomplete in terms of capturing the expected returns.

CHAPTER 4 : Techniques and challenges of event study evaluating methods

Introduction

From the first time that technical performance evaluation appeared in the market through the examination of events appearing in the market and being capable of implying turbulences in the asset performance, there has been a differentiation of the researchers regarding the time depth that should be maintained for the achievement of more representative results. In the bibliography it is indicated that the information diffused on the market and remains to this (creates performances) at least two years since its apperance (Ikenberry, Lakonishok and Vermaelen 1995).

In order to achieve a representative presentation of the unexpected performance created by an event being capable of implying turbulences in the market, two “evaluation techniques” have been appeared in the bibliography.

The events evaluation to a depth of up to 1 year from the announcement date of the information, called “event study in short Horizon Period” and the events evaluation to a depth of more than 1 year from the announcement date of the information called " Long Horizon Event Study ".

For each case there have been developed different ways of performance assessment and different techniques which intend had the best quantification of the event, the finding that the level of shaking that combine because of information appearing on the market.

Furthermore, the key techniques per category that have as criterion the evaluation of turbulence depth, will be presented. We will move into greater depth techniques used in greater than one year measurement periods (Long Run Event Study) for which the main advantages and disadvantages will be displayed.

In the present empirical research techniques have used by the scientific literature on long Horizon Event Study and we have watched the performance of the event throughout two year period.

The main challenge as noted above in carried time power measurement is the selection of a reference point (benchmark) capable of effectively capturing the performance that should have to be if this event never happened. At this point we briefly mention and they will be analyzed (New Listing or Survivor bias, Rebalancing bias και Skewness bias) (βιβλιογραφία) which may lead to outperformance and correlations that may lead us to reject the null hypothesis (leads to rejection to the then the (New Listing or Survivor bias, Rebalancing bias and Skewness bias) (literature) null Hypothesis)

4.1 Short Horizon Event Study

Two most popular methods for Short Horizon Event Studies (Strong 1992)

4.1.1 A.Cumulative abnormal returns (CAR)

Harrington and Shrider (2007) found that in a short-horizon test focusing on mean abnormal returns should always use tests that are robust against cross-sectional variation in the true abnormal return. Corrado (1989) introduced a nonparametric rank test based on standardized returns, which has proven to have very competitive and often superior power properties over the above mentioned standardized test.

In practice this is achieved by dividing the estimation period and event period into intervals matching the number of days in the Cumulative abnormal return. Under the efficiency hypothesis new information should instantaneously, without delays, fully be reflected in stock prices.

$$\text{CAR} = \sum \frac{1}{N} \sum ARit$$

$$\text{CAR}_{i,T} = \sum_{t=1}^{T} ARi,t = \sum_{t=1}^{T} [Ri,t - (ai + \beta iRm,t)]$$

Of the existing non-parametric methods the cumulated ranks test can be expected to be a promising candidate in this respect because it monitors each return via the rank number separately around the event days. This separate monitoring can be an advantage over methods based on accumulated returns. Another advantage of the cumulated ranks test, in particular with respect to above referred multi-day alternative, is its simplicity and uniqueness.

Finally, in short windows of two or three days, which are typically the used window lengths reported in event studies, the cumulative ranks testing procedure can be expected to do fine even if the event is randomly assigned in only one of the dates (Luoma and Pynnönen, 2010).

However, this cumulative ranks procedure has some obvious shortcomings.

Major reasons are:

A. The multiple-day approach does not necessarily lead to a unique testing procedure (Luoma and Pynnönen, 2010).
B. The abnormal return model should be re-estimated for each multiple-day CAR definition.
C. In addition, for a fixed estimation period, as the number of days accumulated in a CAR increases, the number of multiple-day estimation period observations reduces quickly unpractically low and thus, would weaken the abnormal return model estimation (Kolari and Pynnönen, 2010).
D. The procedure looses quickly power to detect an event effect in cumulative abnormal returns if the event effect is randomly assigned to a single event day within the event window for each stock

Kolari and Pynnönen (2010) resolve this undesirable feature by suggesting a procedure in which the cumulative abnormal returns are mapped to the same scale as the single day abnormal returns. This allows for using the rank test in a well defined manner for testing both single day abnormal returns as well as cumulative abnormal returns.

4.1.2 B.Abnormal Performance Index (API)

$$\text{API}=\frac{1}{N}\sum\prod(1+A\bar{\text{R}}it)-1$$

4.2 Long - Horizon Event study.

A large number of papers in finance literature have documented evidence that firms earn abnormal returns over a long time period (ranging from one to five years) after certain corporate events. Kothari and Warner (2007) report that a total of 565 papers reporting event study results were published between 1974 and 2000 in 5 leading journals: the Journal of Business (JB), Journal of Finance (JF), Journal of Financial Economics (JFE), Journal of Financial and Quantitative Analysis (JFQA), and the Review of Financial Studies (RFS).

Approximately 200 out of the 565 event studies use a maximum window length of 12 months or more (Ang and Zhang, 2011). Several simulation studies such as Kothari and Warner (1997) and Barber and Lyon (1997) document evidence that statistical inference in long horizon event studies is sensitive to the choice of methodology. Therefore, it is crucial to gain an understanding of the properties and limitations of the available approaches before choosing a methodology for a long-horizon event study.

At the core of a long-horizon event study lie two tasks:

A. to measure the event-related long horizon abnormal returns
B. to test the null hypothesis that the distribution of these long horizon abnormal returns concentrates around zero.

A proper testing procedure for long-horizon event studies has to do both tasks well. The most serious problem with inference in studies of long-run abnormal stock returns is the reliance on a model of asset pricing (Kothari and Warner, 1996) highlights the problems associated with calculating long-run abnormal returns using either a reference portfolio approach). All tests of the null hypothesis that long-run abnormal stock returns are zero are implicitly a joint test of (i) long-run abnormal returns are zero and (ii) the asset pricing model used to estimate abnormal returns is valid.

Long-horizon event studies of abnormal stock returns deal typically with event windows of several months to years. Unlike short-run event studies using daily stock returns, sample sizes are usually in the hundreds rather than tens of stock return series. Also, in contrast to short-run event studies, there is no separate estimation period in long-run event studies (Knif, Kolari, and Pynnönen, 2014).

As noted in the prior literature, a drawback phenomenon's of cross-correlation biases and bad model problems tend to plague tests of long-run abnormal returns (Fama, Barder, Tsai, Kothari and Warrner). The latter problem of an appropriate expected return model is an unresolved as set pricing issue.

Due to the lack of a reliable mean model in long run event studies, many researchers (Mitchell and Stafford, Eberhart and Siddique, Boehme and Sorescu, Gombers and Lerner, Byun and Rozeff, and others) employ a non-model approach popularized by Lyon, Barber, and Tsai (LBT) [26] that utilizes carefully chosen reference portfolios or reference stocks.

Sharpe ratios to make returns more comparable with respect to each other based on their risk-reward qualities

Cross-correlation problems that are perceived to plague long-horizon event
Study results (Kothari and Warner, Brav, Fama). In order to resolve the problem of cross- correlation Fama, Tsai, Kothari and Warners proved that:

- using appropriate reference portfolios in the abnormal return definition, the cross-correlation problem is virtually eliminated in many cases''

- the choice of the mean model is extremely important in long-run horizon event studies

- Kolari and Pynnönen for short-horizon event studies with clustered event days, it is crucial to choose a mean model that extracts (as much as possible) common cross-correlation in order to improve the power of the tests. In long-horizon event studies, properly defined reference portfolios (or reference stocks) turns out to be a viable method in this respect.
- Kothari and Warner (1996) also analyze the properties of long-run abnormal returns. Both our work and that of Kothari and Warner highlight the problems associated with calculating long-run abnormal returns using either a reference portfolio approach or an application of an asset pricing model
- Mean problem of long run event studies, a remedy for potential cross-correlation problems is suggested by Jegadeesh and Karceski. However, a shortfall of this approach is that the small sample critical values deviate substantially from the theoretical thresholds, which causes severe size distortion in the tests.2
- The paper of Fama, Barder, Tsai, Kothari and Warners shows that the short-run approach in Kolari and Pynnönen can be adapted to long-horizon event studies to efficiently capture cross-correlation bias even in these cases, such that the size of the proposed test is reasonably close to the intended size and its power outperforms other popular tests.
- unlike short-horizon event studies, inferences of long-horizon event studies may lead to deferent end results depending on the return metrics employed
- Another biases which effects the quality of long horizon estimates are new listing or survivor bias and rebalancing bias)

New listing or survivor bias

Survivor bias is inherent in long run event studies due to the introduction of new companies or delistings in the reference index during the event period
(Sampling procedures can be used to control for this bias. Also, as proven by Lyon, Barber, and Tsa)

Rebalancing bias

Rebalancing bias arises because the compound returns of a reference portfolio, such as an equally weighted market index, are typically calculated assuming periodic (generally monthly) rebalancing, while the returns of sample firms are compounded without rebalancing
Rebalancing bias in monthly reference index returns can be avoided by using buy-and-hold abnormal returns (BHARs).

Skewness bias,

Skewness bias arises because long-run abnormal returns are positively skewed.

Two statistical methods virtually eliminate the skewness bias in random samples (Lyon, Barber, Tsai, 1999):

A. a bootstrapped version of a skewness-adjusted t-statistic
B. empirical p values calculated from the simulated distribution of mean long-run abnormal returns estimated from pseudo portfolios.

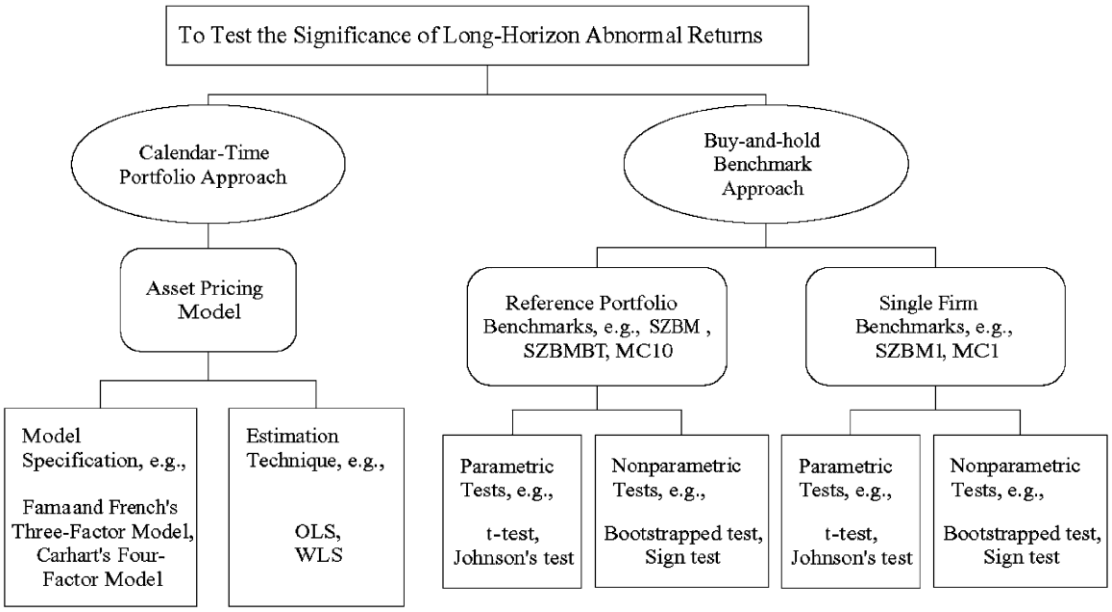
The first method is developed and analyzed based on a rich history of research in statistics that considers the properties of t-statistics in positively skewed distributions, which dates back at least to Neyman and Pear- son (1928) and Pearson (1929a, 1929b). In the second method, based on the empirical methods of Brock, Lakonishok, and LeBaron (1992) and Ikenberry, Lakonishok, and Vermaelen (1995).

These two statistical methods yield well-specified test statistics in random samples, and in combination with carefully constructed reference portfolios, they control well for the new listing, rebalancing, and skewness biases. However, the methods are unable to control for two additional sources of misspecification: Cross-sectional dependence in sample observations, and a poorly specified asset pricing model. Brav (1997) argues that cross-sectional dependence in sample observations can lead to poorly specified test statistics in some sampling situations and we concur.

Barder and Lyon, 1996 find that cumulative abnormal returns (summed monthly abnormal returns) yield positively biased test statistics, while buy-and-hold abnormal returns (the compound return on a sample firm less the compound return on a reference portfolio) yield negatively biased test statistics. These apparently contradictory results occur because of the differential impact of the new listing, rebalancing, and skewness biases on cumulative abnormal returns and buy-and-hold abnormal returns. Using control firm approach for detecting long-run abnormal stock returns. We document that matching sample firms to control firms of similar sizes and book-to-market ratios yields test statistics that are well specified in virtually all sampling situations that we consider. This control firm approach yields well-specified test statistics because it alleviates the new listing, rebalancing, and skewness biases

1. Long horizon event study lies two tasks: fist to measure the event related long horizon abnormal returns and second to test the null hypothesis that the distribution of these long horizon abnormal returns concentrates around zero.
2. Two types of error could be committed and lead to incorrect inference. The first error arises when the null hypothesis is reject not because the event has generated true abnormal returns but because a biases benchmark has been used to measure abnormal returns. A biases benchmark leads to false rejection of the null hypothesis. The second error is committed when the null hypothesis is accepted not because the event has no impact , but because the test itself does not have enough power to statistically discriminate the mean abnormal return from zero

3. Two promising approaches have been followed in recent finance literature to measure and test long-term abnormal returns. The first approach forms a portfolio in each calendar month consisting of firms that have had an event within a certain time period prior to the month, and tests the null hypothesis that the intercept is zero in the regression of monthly calendar-time portfolio returns against the factors in an asset-pricing model. The second approach uses a benchmark to measure the abnormal buy-and-hold return for every event firm in a sample, and tests whether the abnormal returns have a zero mean.
4. For calendar time portfolio approach, researchers choose an asset pricing model and estimation technique to fit the mode. The most popular asset pricing models are 3FF factor model (Fama and French 1993) and Four factor model (Carhart 1997) that includes an additional momentum-related factor.
   Two techniques are commonly used to fit the pricing model. The ordinary least squares (OLS) techniques and the weighted least squares (WLS) technique.
5. On the other hand, if adopting the buy-and-hold benchmark approach, researchers choose either a reference portfolio or a single control firm as the benchmark for measuring abnormal returns and select either parametric or nonparametric statistic for testing the null hypothesis of zero abnormal return



(Overview of the two approaches to choose a methodology for long-horizon event study. JAMES S. ANG *and* SHAOJUN ZHANG 2004)

Long-horizon results are potentially very sensitive to the assumed model for generating expected returns. The failure to use the correct model could result in systematic biases and misspecification (Fama and French, 1993, pp. 54 55)

One possible strategy to counteract this long litany of problems is to test the statistical significance of post event abnormal returns with three difference statistics:
a) Buy and hold abnormal returns (BHARs) use more than one test.
b) Wealth relative ratios (WR) proposed by Ritter 1991 and
c) A Percentage buy and hold abnormal returns (PBHARs) proposed by Erasmo Giambona, Carmelo Giaccotto and C.F Sirmans

4.2.1 Buy and Hold benchmark approach

Two commonly used methodologies for investigating the long-term stock price performance following major corporate events are the buy-and-hold abnormal return (BHAR) approach and the calendar time portfolio (CTAR) method. The BHAR is defined as the difference between the long-run holding period return of a sample

firm and that of some benchmark asset. Mitchell and Stafford (2000) explain BHAR returns as the average multiyear return from a strategy of investing in all firms that complete an event and selling at the end of a pre-specified holding period versus a comparable strategy using otherwise similar nonevent firms. The calendar time method, on the other hand, is based on the mean abnormal time series returns to monthly portfolios of event firms.

Following the work of Ritter (1991), the BHAR becomes one of the most popular estimators in the literature of long-horizon event studies. A large number of papers have applied the BHAR approach in measuring long-horizon security price performance. Important examples include Barber and Lyon (1997) and Lyon, Barber, and Tsai (1999) (henceforth LBT). These studies document that an appealing feature of using the BHAR is that the buy-and-hold returns better resemble the investors' actual investment experience than periodic (monthly) rebalancing entailed in other approaches measuring risk-adjusted performance.

Fama (1998), however, argues against the BHAR methodology because of the statistical problems associated with the use of BHAR and the relevant test statistics. He reports that the BHAR does not address the issue of potential cross-sectional correlation of event firm abnormal returns. Mitchell and Stafford (2000) also question the application of the BHAR approach suggesting that the assumption of independence of observations is violated and hence the cross-sectional correlations significantly bias the test statistics that are computed from the BHARs.

For long-term event studies, two alternative methodologies to calculate risk-adjusted post-event performance exist. Besides the buy-and-hold abnormal return (BHAR) approach (described in the event study blueprint), scholars have developed the method of calendar-time portfolios (CTIME). The method is also known as the Jensen's alpha approach.

BHARs are computed as the difference between the sample firm's buy and hold returns and it's compounded expected return under the null hypothesis.

$$\text{BHARi}=\prod_{t=1}^{T}(1+rit)-E(\prod_{t=1}^{T}(1+rit))$$

Where,

- T : is the number of months after the announcement over which to measure the BHAR,
- r_{it} :is the return of firm I in month t
- E (*): is its expected return under the null of no abnormal performance.

Typically, this expected return is approximated by a reference portfolio or some benchmark.

Standard assumption in event studies is that r_{it} is a normally distributed random variance.

Hence we use the idea of a reference portfolio as a proxy for the expected holding period return E $(\prod_{t=1}^{T}(1+rit)$The long horizon buy and hold return for the reference portfolio (BHRrp) for event firm is obtained by compounding the returns of security.

Earlier studies (Boehme & Sorescu, 2002; Jegadeesh & Karceski, 2009; Mitchell & Stafford, 2000) report that the BHAR approach does not control well for the cross-sectional correlation among individual firms in nonrandom samples, and thus yields misspecified t-statistics

4.2.1.1 Disadvantages of BHARs method

New-listing biased: Reference portfolio may include newly listed firms while sample firms have been usually tracked for a longer time. Because newly listed firms, in general, underperform their benchmarks, the corresponding long horizon BHAR may be upward biases.

A Rebalancing bias arises when reference portfolios are periodically (for instance monthly) rebalanced, whereas sample firms do not change over the same time

horizon. If all securities have to maintain the same weight over time then it is implicitly assumed that securities that have outperformed the market average are sold while securities that have underperformed the market average are bought. This rebalancing process is problematic for the following reason: If monthly returns for individual securities are negatively correlated then the rebalancing process is implicitly done by selling securities that will not perform well in the coming month and by buying securities that should perform above the market average during the same time frame. Mean reversion will create an upward bias in the reference portfolio. Hence, large portfolio returns, in part due to negative serial correlation , do not necessarily reveal a profitable strategy.

End of period stock prices quite often represent bid or ask quotes rather than actual market prices. Indeed, Blume and Stambaugh (1983) found the securities with high returns at time t-1 have a higher probability of being recorded as traded at the ask price at time t , whereas securities with low returns at time t-1 have a higher probability to be recorded at tje bid price at time t. This bid - ask bounce creates negative serial correlation in the monthly returns of individual firms and it biases the return of an equally weighted reference portfolio. However, this problem is more pronounced in daily rather than monthly returns.

Bad model Problem. This problem arises because any test against the null hypothesis of zero abnormal returns is a joint test of the hypothesis and the specification of the asset pricing model used to conduct the test (Fama 1970, 1998).

In order to avoid all this disadvantages of buy and hold methods it is necessary to be accurate in selection of reference portfolio (benchmark).

4.2.1.2 Difference between cumulative abnormal return (CAR) and buy and hold methods (BHAR) (Barber and Lyon, 1997)

Ritter (1991) was among the first to argue that CARs and BHARs can be used to answer different questions. Consider the case of a 12-month CAR and an annual BHAR. Dividing the 12-month CAR by 12 yields a mean monthly abnormal return. Thus, a test of the null hypothesis that the 12-month CAR is zero is equivalent to a test of the null hypothesis that the mean monthly abnormal return of sample firms during the event year is equal to zero

- CARs ignore compounding, while BHARs include the effect of compounding
- If individual security returns are more volatile than the returns on the market index, it can be shown that CARs will be greater than BHARs if the BHAR is less than or equal to zero.
- As the annual BHAR becomes increasingly positive, the difference between the CAR and BHAR will approach zero and eventually become negative.
- Cumulative abnormal returns are most affected by the new listing bias.
- long-run buy- and-hold abnormal returns are more affected by the rebalancing and skewness biases.

We advocate the use of buy-and-hold abnormal returns over cumulative abnormal returns for two reasons.

Figure 8

Cumulative vs Buy and Hold Abnormal Returns – Advantages and Disadvamtages

Advantages and disadvantages

Join Hypothesis test

- All models are subject to join hypothesis test that the market is efficient and the mode is able to capture the variation of expected returns (Fama 1998)
- BHAR is less susceptible to join hypothesis test, as the use of an asset pricing model is not common. BHAR investigates whether the event and control samples have similar return patterns and not whether market is efficient (Loughram and Ritter, 2000)

Bad model problem

- Expected returns are misspecified, especially when firms have small size and high growth (Fama, 1998) CAR and BHAR yield misspecified AR.
- BHAR is less susceptible to bad model problems, as it does not directly examine for market efficiency. Using characteristics match approach , BHAR avoid the violation of assumptions such as linearity and independency between the factors in the model (Loughran and Ritter, 2000)

Ability to capture the variation of expected returns

- Lower ability of CAR to measure expected returns , because of common use of (theoretical) asset pricing models that are widely accepted , which also examine market efficiency
- BHAR are more able to capture the cross sectional variation of expected returns. Using theoretical asset pricing models is not common in BHAR contrary to the choice characteristics based benchmarks

Reflection of actual investor return

- BHAR reflect the actual investor return –takes the compounding into account
- CAR ignores compounding (measurement bias) (Barber and Lyon , 1997 Loughran and Ritter, 1997 and Lyon et al.,1999)

New listing bias

- New listing firms underperforms a few years following their IPO (Ritter and Welch, 2002)
- All models of expected returns are sublect to new listing bias as they use benchmarks that include IPOs (expect single-firm matching if relevant controls are imposed)
- Positive bias to AR, which may yield misspecified test statistics (Type I error) (Brav and Gompers, 1997)
- CAR and BHAR are subject to new listing bias , especially when portfolios/indexes are used.

Rebalancing bias

- Benchmark sample is subject to rebalancing but the event sample is not
- CAR and BHAR are subject to rebalancing bias
- All models of expected returns are subject to rebalancing bias (except single firm matching if relevant controls are imposed and CTAR)
- Negative bias to AR, which may yield misspecificed test statistic (Type I error). This is because the empirical rejection rates exceed the theoretical ones. (Kothari and Warner, 1997; Barber and Lyon, 1997; Lyon et al ,1999; Mitchell and Stafford, 2000).

Survivorship bias

- Event sample AR are computed for a long event periods , but firms constituting the benchmark often include firms that cease trading before the end of tested period.
- Positive bias to AR

- BHAR should not be as sensitive to delisted return bias as CAR
- Two common delisting return treatments a) drop delisted returns (immediately or after the next rebalancing) b) replace delisted returns with the benchmark return. This bias AR towards zero (Shumway, 1997; Shumway and Warther, 1999).

Weights

- Especially for small stocks , when AR are equally weighted , the portfolio is more sensitive to new listing , rebalancing and delisting bias (Type II error) than when AR are value weighted
- Value weighted benchmarks could have higher return variances in period with large weights of a single firm (because its systematic risk is not weighted)
- Value weighting limits the bad model problem, as small stocks have smaller weight than when weights are equal (Loughran and Ritter, 2000).

(In)Dependence

- CAR and BHAR are subject to cross sectional and time series dependence (not when CTAR
- CAR and BHAR are subject to overlapping returns, generating misspecified test statistics (Brav, 1997; Lyon et al, 1999; Mitchell and Stafford, 2000).

Normally assumption

- CAR and BHAR are not identically independent distributed
- Traditional parametric t-statistics do not satisfy tha assumed zero mean and unit normality assumptions
- Periodic parameters shift over the estimated period AR are not identically independent distributed (they are right skewed , causing positive bias)
- BHAR indicate more obvious problems of skewness and cross sectional dependence (due to the compounding) than CAR (Lyon et al , 1999; Mitchell and Staffors , 2000)

Suggestions

- Match with single control non event firm
- Careful portfolio construction to control for known biases
- Non – parametric tests including bootstrapped approaches (Ikenberry et.al, 1995 ; Lyon, 1997 ; Brav, 2000)
- Use of value weighted portfolios (Loughran and Ritter , 2000 ; Liu and Strong, 2008)
- Variations of Fama - McBeth parametric tests (Dichev and Piotroski , 2001; Peyer and Vermaeen , 2005)

This table summarizes the advantages, disadvantages and suggested solutions related to biases of cumulative abnormal returns (CAR) and buy and hold abnormal returns (BHAR). AR stands for abnormal returns and CTAR for calendar time abnormal returns (Choosing Among Alternative long run event study techniques Dionysiou, 2015)

4.2.2 Calendar time portfolio approach

Since Jaffe (1974) and Mandelker (1974), the method of calendar-time portfolios has been used in many studies such as Barber and Odean (2000 and 2001), Brav and Gompers (1997), Jeng, Metrick and Zeckhauser (2003), or Mitchell and Stafford (2000). It is a standard method in fund research and it is also frequently used in behavioral and corporate finance.

The basic idea of the approach is to develop a portfolio of firms for which the event of interest occurred and define the abnormal return earned by this portfolio as the portfolio's excess return (i.e., the return over the risk-free rate) that cannot be explained by risk-factor models used to predict expected returns (the CAPM and the three- and four-factor models).

This is what gives the Calendar time approach its alternative name "alpha approach": if the aforementioned models for expected return estimation are correct (i.e., capture all factors necessary to explain expected returns), the intercept – often denoted as alpha – in a time-series regression on realized returns that empirically tests these models should be statistically insignificant and close to zero. This means that a portfolio (i.e., a trading strategy) generating statistically significant alphas larger than zero creates positive abnormal returns, or put differently, beats the market. Thus, the CTAR approach, similar to the BHAR approach, resembles the investors' actual investment experience.

The methodology of calendar-time portfolios is an approach of simulating portfolios, or trading strategies, which involves two general steps:

A. the calculation of average excess returns of the rolling portfolio of event firms
B. the time-series regression of the excess returns on a number of risk factors depending on the model chosen to predict returns

The period of months over which each stock of an event firm is included in the rolling portfolio (after the event) can be chosen freely. Usually, 12 to 60 months are

considered. The length of the period event firms remain in the portfolio after the event corresponds to the performance persistence one wants take into account.

4.2.2.1 Standardized calendar time approach

However, a number of firms in the sample often produce volatile returns. Small firms, for instance, usually exhibit such pattern and because of this volatility, the distributions of long-run returns tend to have fat tails. But one possible solution to this problem is standardizing the abnormal returns by their volatility measures (Anupam Dutta, 2015).

The conventional way of calculating the mean monthly calendar time abnormal return (CTAR) is the following:

4.2.2.2 Mean monthly calendar time abnormal return

$$\text{CTAR} = \frac{1}{T}\sum_{t=1}^{T} CTAR_{\text{t}}$$

Where,

$$\text{CTAR}_{\text{t}} = \text{Rpt} - \text{E}(\text{R}_{\text{pt}})$$

- Rpt : is the monthly return on the portfolio of event firms
- E(Rpt) : is the expected return on the event portfolio which is proxied by the raw return on a reference portfolio
- T : is the total number of months in the sample period.

4.2.2.3 Buy and Hold Abnormal Returns vs Calendar time Abnormal Returns

Although, of course, one can calculate both buy-and-hold returns and calendar-time portfolios, the question arises which approach should be preferred. In this regard, the major criterion is the reliability of the two approaches.

Several financial economists, including Nobel laureate Eugene Fama, advocate the calendar time portfolio approach. Fama (1998) argues that the BHAR approach does not adequately control for cross-sectional correlation among individual firms. This can lead to overstated test statistics as shown by Mitchell and Stafford (2000) and may hence produce less reliable results. An important statistical advantage of using the calendar-time portfolios approach is that it uses a time-series of portfolio returns.

As a result, the portfolio variance includes the cross-correlations of firm abnormal returns and the problem of cross-sectional dependence is eliminated (Lyon, Barber and Tsai, 1999). Further, Mitchell and Stafford (2000) provide evidence that the distribution of the estimator in the calendar time portfolio approach is well-approximated by the normal distribution. This favors robust statistical inference.

Another disadvantage of the BHARs approach, mentioned in Eckbo, Masulis and Norli (2000), is that it is not a feasible portfolio strategy because the total number of securities is unknown in advance. Prominent criticism against the CTAR approach is

brought forward by Loughran and Ritter (2000) who argue that this approach is potentially biased to find results consistent with market efficiency as it does not put enough weight on managers' timing decisions of corporate events.

In fact, the logic of timing certain corporate events, such as debt or equity issues or dividend payments (Baker, 2009; Baker and Wurgler, 2002 and 2004), implies that corporate managers endogenously time corporate events and partly capitalize misevaluations varying over time in the capital markets. Yet, as the CTAR approach weights each time period equally, it can have a lower power of detecting abnormal returns in case firms time their corporate actions. To mitigate this potential problem, Fama (1998) suggests weighting calendar months with their statistical precision which depends on the sample size of each monthly portfolio.

Further investigation of Dionysis Dionysiou (2015) summaries observed with the advantages and disadvantages of use of two methods

Figure 9

Buy and Hold Abnormal Returns vs Calendar time Abnormal Returns Advantages and Disadvantages

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Advantages

Buy and hold estimations techniques

- Less sensitive to bad model problem
- Does not directly examine market efficiency as it compares whether the event and control samples have similar return patterns
- Easy to match firms according to characteristics and identify proper risk factors
- Single firms – matching can avoid kwon biases

Calendar time Abnormal Return estimations techniques

- Not subject to rebalancing bias (event and benchmark samples roll)
- Free of benchmark data availability problem. If potential matching company does not have available data during the matching process, the firm is completely excluded from the analysis. However with periodical rebalancing , the procedure is repeated in each calendar month and all potential matching firms are taken into account
- No explicit measurement of size and BTM for event firms (comparisons between small - large firms and firms with high-low BTM)
- CTAR approach eliminates the cross sectional dependence problem among sample firms and automatically accounts for the portfolio variance because returns are averaged into a single portfolio each month
- CTAR approach avoids the overlapping problem since the returns are calculated in calendar –time rather than event-time

- CTAR distribution is closer to normal, allowing for classical statistical inference. It yields more robust test statistics in non random samples (Fama, 1998 ; Mitchell and Stafford , 2000; Brav ,2000; Ritter and Welch, 2000)

Biases / Shortfalls

Buy and hold estimations techniques

- Subject to new listing and survivorship bias (except when matching approach impose relevant controls)
- Subject to rebalancing bias (expect when matching approach imposes relevant controls)
- Weighting may significantly affect BHAR depending on the sample (firm size and BTM)
- Any errors and /or miss estimations in the event period will shift over time. Even when no returns are reported , AR are carried through the following period sand spurious upward drift bias is mitigated
- BHAR indicate more obvious problems of swewness and dependence in comparison with CTAR (Kothari and Warner, 1997; Mitchell and Stafford, 2000 ; Brav, 2000)

Calendar time Abnormal Return estimations techniques

- Subject to new listing and survivorship bias
- By forming event portfolios power is likely to be sacrificed. Returns within the event portfolio are averaged over the months ignoring the frequency of event activities. The sum of OLS is minimized , limiting power to detect AR (type II error)

- Since firms in the event portfolio change through time, factors such as industry and/or time clusters are likely to change too. Hence, the true slopes on the risk factors are time varying whereas CTAR assumes sable firms characteristics over time. As the intercepts can embody factors other than what is explicitly being controlled for, they may yield misspecified test statistics.
- As firm number is likely to change through time, the portfolio variance is affected. This would probably cause residual heteroskedasticity and misspecify the intercept
- More sensitive to the join hypothesis test any asset pricing model assumes linearity between the factors, which is unlikely to hold for the SMB and HML factors. The model assumes the factors are independent which seems to be violated especially for small firms (Loughran and Ritter , 1997; Brav and Gompers , 1997; Lyon et al, 1999; Loughran and Ritter , 2000)

Suggestions

Buy and hold estimations techniques

- Match with single control non event firm
- Careful portfolio construction, controlling for known biases
- Use of value – weighted portfolios
- Variations of Fams – Mc Beth parametric tests
- Non parametric tests
- Bootstrapping approaches (Ikenberry et al, 1995; Lyon et al, 1999; Brav, 2000; Loughran and Ritter , 2000; Ditchev and Piotroski, 2001 ; Peyer and Vermaelen, 2005; Liu and Strong , 2008)

Calendar time Abnormal Return estimations techniques

- 10 firms in each calendar to portfolio to avoid heterodeskedasticity (Hertzel et al, 2002 ; Mitchell and Stafford , 2000)
- A common correction if heteroskedasticity for equally weighted portfolios is to standardize the CTAR by the calendar- time portfolio variance (Franks et al, 1991)
- Use of appropriate asset pricing model to account for even characteristics and other factors (Lyon et al, 1999 ; Eckbo et al, 2000 ; Brav et al, 2005; Petkova, 2006; Eckbo and Norli, 2005; Liu, 2006)

This figure contrasts the most frequently used methods nowadays, namely event time buy and hold abnormal returns (BHAR) and calendar time abnormal returns (CTAR) AR stands for abnormal returns (Dionysiou, 2015)

4.3 Cross – sectional correlation in standardized abnormal returns:

1. A Basic assumption in traditional event study methodology is that the abnormal returns are cross sectional uncorrelated
2. Standardize tests are valid only if there are no cross sectional correlation between the observation returns (in paper of James Kolari and Seppo Pynnonen proposed simple corrections of test statistics to account such correlations) A methods which used to measure the impacts of sectional correlation in standardized abnormal returns its produced via simulation analyses using daily returns. A method witch used relied by formulas that correct the original Patell T-statistic and the original BMP T- statistic for cross-sectional correlations. Simulation results shows that moderate events produce cross sectional correlations in the residual returns which reject the null hypothesis

3. Cross – correlation in abnormal returns is largely irrelevant in short – window event studies when the event is not clustered in calendar time. However , in long – horizon event studies , even if the event is not clustered in calendar time , cross – correlation in AR cannot be ignored. Long – horizon abnormal return tend to be cross correlated because a) abnormal returns for subsets of the sample firms are likely to share a common calendar period due to the long measurement period b) corporate events like mergers and share repurchases exhibit waves c) some industries might be over represented in the event sample
4. In literature, Patell 1976 and Boehmer Musumeci and Poulsen (1991) shows outperform traditional of standardized methods(Non standardized tests in event studies).
5. In order to assume null hypothesis of cross sectional correlation returns it is necessary to investigate the influence of event in the normality returns of the firms. This assumption is valid when the event day is not common to the firms or if its common (event day) the firms are not for the same industry
6. Brown and Warner (1982 and 1985) shows that measurements normality of abnormal returns using market is valid (Abnormal return reduces the inter – correlations virtually to zero). Nevertheless it is well known that, if the firms are from the same industry or have some other commonalities extractions of the market factor may not reduce the cross sectional residual correlation. Consequently the value of t statistics relying on independence understate the standard errors an lead to severe over rejection of the null hypothesis of no event effect when it is true.
7. Jaffe at 1974 introduce methods which firms returns are aggregates in an equally weighted portfolio and the abnormal returns of the portfolio are investigated. While this captures the contemporaneous dependency between the returns it is generally sub optimal.
8. The Generalized least squares (GLS) is known to be optimal under certain assumptions but it requires accurate estimation of the covariance matrix of the returns which is not always possible, particularly if the number of firms is larger than the number of time points in the estimation period. Also the cost of estimating the large number of covariance parameters witch needed in GLS

introduce even more inaccuracy into standard errors. Chandra and Balachndran (1990) conclude that GLS should be avoided in event studies because the correct model specification is rarely known for certain.

9. Most relevant standardized methods are the Patell 1976 T-statistic tp= and Boehmer Musumeci and Poulsen 1991 T- statistics. However both of these methods based on the assumption that the abnormal returns are contemporaneously uncorrelated. Patell in order to resolve this assumption introduce a methods which aggregate the standardize abnormal returns using an equally weighted portfolio and compute the T-statistic ftom the portfolio returns. Unfortunately the portfolio methods does not work in the Boehmer , Musumeci and Poulsen (BMP) approach

   Formula of Patell's (1976): $tp=\frac{A\sqrt{n}}{\sqrt{m-2}/\sqrt{(m-4)=}}=A\sqrt{\frac{n*(m-4)}{m-2}}$

   A:Is the average of standardized abnormal returns over the sample of n firms on the event day, Standardized abnormal return are calculated by dividing the event period residual by the standard deviation of the estimation period .

   m:Is the number of observation (days, months in the estimation period)

   Formula of Boehmer et (1991) estimate the cross sectional variance of the standardized abnormal returns and define a T-statistic as: $t\beta=\sqrt{\frac{A\sqrt{n}}{s}}$

   s: is the cross sectional standard deviation of the standardized abnormal returns.

10. The advantage of Patell method as well as the BMP method is that they weight individual observations by the inverse of the standard deviation , which implies that more volatile(more noisy) observation get less weight in the averaging than the less volatile and hence more reliable observations. A major drawback of both methodologies (Patell and BMP) T-statistics is that if the event day is the same for the firms the T-statistics do not account contemporaneous return correlations.

4.3.1 Attempt to address serial correlation bias and rebalancing bias

An important question to be answered is, whether it is feasible the measurement of unexpected performance with techniques which avoid or at least restrict the phenomenon of outperformance, underperformance of the estimator model. The common problem that leads to the rejection of the statistical significance of the model is the phenomenon of autocorrelation and the correlation in particular against long horizon assessment.

The Researchers Erasmo Giambona , Carmeno Giaccotto and C.F. Sirmans in order to retain the statistical significance of the estimates of non-expected performance in post event periods 3 sample techniques

A. Long Horizon buy and hold return for reference portfolio (BHRRP)

$$BHR_{RPi} = \sum_{j=1}^{n1j} \frac{[\prod_{t=1}^{T}(1+rjt)]}{n1i}$$

Where,

N1 : is the number of firms in the reference portfolio for firm I in month 1

Rjt : is the market return of firm j in month t

Using this formoula Erasmo Giambona , Carmeno Giaccotto and C.F. Sirmans they argue that they avoid the problems of new listing and rebalancing bias and

The test of null hypothesis can be performed using the test statistic

$$tBHAR = \frac{\overline{BHARt}}{\frac{\sigma(BHARt)}{\sqrt{n}}}$$

where,

$\overline{BHARt}$: is the sample average buy and hold abnormal return

σ(BHARt): is the cross sectional sample standard deviaton

n is the total number of event firms.

B. Wealth relative ratios (WR) proposted by Ritter 1991

$$WRi=\frac{\prod_{t=1}^{T}(1+rit)}{BHRrpi}$$

C. Percentage buy and hold abnormal return (PBHARs)

$$PBHARt=\frac{\prod_{t=1}^{T}(1+rit)}{\prod_{t=1}^{T}(1+rBt)}$$

Where,

Rit : is the firm I return in month t

Rbt : is the reference portfolio return in month t ($rbt=\frac{\sum_{j=1}^{nj} rjt}{nj}$)

T: is the number of months after stock repurchase announcement

Ratio should be greater than one for firms with positive abnormal performance relative to their appropriate benchmark

The result of the research appears compelling evidence of positive and significant long horizon abnormal returns in the 24 months following the announcement. This finding is consistent with the under reaction hypothesis by Ikenberry , Lakonishok and Varmaelen 1995. According to this hypothesis , the market reacts skeptically to the announcement of a stock repurchase program and therefore prices remain undervalued for a relatively long period of time. Likewise the PBHAR estimator may be affected by the serial correlation of monthly returns (autocorrelation bias). The

methodology of PBHAR models the serial correlation of monthly excess returns and therefore the estimates of expected returns is free of serial correlation bias and rebalancing bias

Statistical Tests and Simulation Method

A. Conventional t-statistic

To test the null hypothesis that the mean buy-and-hold abnormal return is equal to zero for a sample of n firms, we first employ a conventional t-statistic $t= \frac{AR}{\sigma(ARt)/\sqrt{n}}$ where ART is the sample mean and σ(AR,) is the cross-sectional sample standard deviation of abnormal returns for the sample of n firms.

B. Bootstrapped Skewness-Adjusted t-statistic

Barber and Lyon (1997a) document that long-horizon buy-and-hold abnor-mal returns are positively skewed and that this positive skewness leads to negatively biased t-statistics. Their results are consistent with early investigations by Neyman and Pearson (1929a), and Pearson (1929a, 1929b), which indicate that skewness has a greater effect on the distribution of the t-statistic than does kurtosis and that positive skewness in the distribution from which observations arise results in the sampling distribution of t being negatively skewed. This leads to an inflated significance level for lower-tailed tests (i.e., reported p values will be smaller than they should be) and a loss of power for upper-tailed tests (i.e., reported p values will be too large). Abnormal returns calculated using the control firm approach or buy-and-hold reference portfolios eliminate the new listing and rebalancing biases. Barber and Lyon (1997a) also document that the control firm approach eliminates the skewness bias. However, to eliminate the skewness bias when long-run abnormal returns are calculated using our buy-and-hold reference portfolios, we advocate the use of a bootstrapped skewness - adjusted t-statistic

4.4 Statistical Hypothesis Testing: A General Approach

The statistical hypothesis testing (hypothesis testing) is an inferential process / method offered by the Statistical Inference which applies in stochastic problems pertaining to decision- making between two alternative hypotheses. One hypothesis is denoted with H_0 and is called null hypothesis and the other is denoted with H_1 and is called alternative hypothesis (Damodar Gujarati, 1992 Essentials of Econometrics) .

The prerequisite for the right implementation of statistical tests and mainly for the correct interpretation of their results is the deep understanding of their rationale and their essence.

Basic Idea

The general idea of statistical hypothesis testing procedure is described as follows: We set the hypothesis which is in doubt as null hypothesis H_0 and we then examine whether a random sample taken from the population advocates- provides ground in favor of its rejection, against the alternative H_1

In other words, H_0 is rejected or not rejected upon taking into the observations made on the random sample taken from the population. More specifically, assuming that H_0 is true, if what is observed in the sample is extreme, namely, the chances to happen are really low, then H_0 is rejected. Contrariwise, namely in the case that the sample observations are not extreme- rare (when H_0 is true), then the sample taken doesn't provide sufficient evidences for the rejection of H_0 and consequently we fail to reject it (Damodar Gujarati, 1992 Essentials of Econometrics, Chapter4).

At this point, it should be also noted that even with this strategy there is always a risk assumed, given that even extreme scenarios which seem unlikely to happen, may become true at the end.

More specifically, assuming that H_0 is true, if we decide that the observations made on the *random sample* are extreme and H_0 is rejected, then one of the following may have happened (Seth Armitage , 1995):

(A) either H_0 is not actually true, so a right decision has been taken,

(B) either the H_0 is true and the extreme is due to chance,

and probably an extremely rare event took place (a rare sample appeared). In this case, the H_0 has been mistakenly rejected. This mistaken is called type I error , that is , the error of rejecting a hypothesis when it is true.

It is also likely not to reject the H_0 by mistake. In other words, it is possible that we may fail in rejecting the H_0, while the H_1 is true. This kind of mistake is called ***(type II error)*** which is the error of accepting a false hypothesis (An Evaluation of Testing Procedures for Long Horizon Event Studies ,James S. ANG Shaojun Zhang 2004).

Ideally, we would like to minimize both these errors. But , unfortunately, for any given sample size, it is not possible to minimize both errors simultaneously. The classical approach to this problem , embodied in the work of statisticians Neyman and Pearson , is to assume that a type I error is likely to be more serious in practice than a type II error. Therefore , one should try to keep the probability of committing a type II error at a fairly low level , such as 0,01 or 0,05 , and then try to minimize a type II error as musch as possible (Robert L. Winkler, introduction to Bayesian inference and Decision, Holt , Rinehart and Winston., New York , 1972).

Consequently, there is double risk with following possibilities

Symbolically,

• **Erroneous rejection of H_0,**

P (type I error) = P (rejection of H_0 | true H_0) and

• **Erroneous omission of rejection of H_0,**

P (type II error) = P error (non-rejection of H_0 | true H_1).

Generally, H_0 shows that the situation of the population remains unchanged, there is no change/ difference or else, that the independent coefficient has no impact on the dependent variable for the population. (Seth Armitage, 1995 Journal of Economic Surveys p.26)

A second rule for determining H_0, which has also been established in international scientific practice, is the following: As null hypothesis we set the case which- if rejected- may pose more risks; in other words the case which should be better protected from a type I error. (Seth Armitage, 1995 Journal of Economic Surveys p.26)

In general, H_1 indicates that there is a change/ difference in the population or otherwise that the independent variable has impact on the dependent variable for the population.

4.4.1 Hypotheses testing

One- tailed test

A. Right-tailed test

$Ho: \mu \leq \mu_0$

$H_1 : \mu > \mu_0$

B. Left- tailed test

$Ho: \mu \geq \mu_0$

$H_1 : \mu < \mu_0$

Two-tailed test

$H_0 : \mu = \mu_0$

$H_1 : \mu \neq \mu_0$

It should be also noted that the two sets of values of the parameter which are tested difinign the two hypotheses should obviously be disjoint (or the one being a negation of the other); in addition these two hypotheses are referred to the population and that's the reason why they are declared/symbolized with terms of population parameters.

The predefined to lerance level of type I error, is denoted with the symbol α and is called *level of significance* of the control (because it shows the value of the critical value c that specifies whether what is observed in the sample is important, constituting an important evidence in favor of the rejection of H_0 (Damodar Gujarati, 1992 Essentials of Econometrics).

The constant c is called the critical value or rejection limit (critical value, rejection limit) because based on this constant it is determined whether a value of a statistical function, t, is extreme or not. Accordingly, the statistical function t, is called test statistic and the values for which the H_0 is rejected, define the critical region or rejection region. When the H_0 is rejected, the sample is characterized statistically significant which actually means that it differs significantly from what was expected from H_0.

It is also noted that by setting lower significance level (a), more "substantial evidences" are required to reject the H_0 and to define our findings in the sample as statistically significant. Thus, at a level of significance a, e.g. a = 0.05, H_0 may be rejected and at a lower level, e.g. a = 0.01, it may not be rejected because more important evidences are required. The lower the significance level at which H_0 may be rejected, the more important the statistical control function value observed in the sample is, in the sense that it provides stronger evidences against H_0.

Therefore, the lower the significance level at which H_0 may be rejected, the more statistically important is the test result.

Finally, it is obvious, that if H_0 is rejected at a significance level a, then it may also be rejected at any higher level; if H_0 is not rejected at any significance level a, then it is not rejected at any lower level.

Figure 10

Steps of testing statistical significance level (a)

Step 1: Define the two cases

Step 2: Define the significance level of control eg a = 0.05

Step 3: Define the statistical test function

Step 4: Select from a random population sample and calculate the value of the statistical test function:

Step 5: Define the critical test region (rejection area):

Step 6: We examine if the value of statistical test function is or not in the critical test region (rejection region) and decide with probability of type I error, e.g. a = 0.05, to reject or not the null hypothesis:

(Theory of Statistics 2000-20013 James E Gentle)

The express of the result must undoubtedly indicate the significance level (a) of control, because this is the main criterion to determine if what is observed in the sample is statistically significant or not and consequently if the null hypothesis should be rejected or not.

It should be also clarified that when we say " rejection area" we always mean 'rejection area of H_0'. In this way what is achieved is to put under our control the type I error, that is, to decide with a known- predefined probability of false rejection of H_0.

4.4.2 Calculating of P-value of the sample

As probability P-Value of the sample or critical level is called the probability which show the statistical control function value that occurred or a further (more extreme), the direction of H_1, since the Ho is true. Therefore, the smaller the P-Value the stronger evidence against Ho arising from this random sample or else more important is the value of statistical control function by the sample

Thus, calculating the P-Value, we may directly compare it with any a, we may choose and then decide to reject or not H_0.

The decision rule is now configured as follows

• if a ≥ P-Value, then at a significance level a, H_0 should be rejected.

• if a <P-Value, then at a significance level a, H_0 should not be rejected.

Summarizing, it is obvious from the above that:

1. P-value may be also defined as follows: P-Value is the minimum value of the significance level for which Ho is rejected.

2. P-value is a measure that expresses how strong are the evidences derived from the sample, against Ho.

4.4.3 The probability of type II error and the power of a statistical test

In statistical hypothesis testing procedure that has been above described, there has been no discussion regarding what happens with the probability of false non /omission of rejection of H_0, namely the probability of type II error. Said probability is denoted with symbol β. So, while H_0 is rejected, we know with what probability our decision may be wrong (is too a); on the contrary, if H0 is not rejected, with those hitherto mentioned, we do not know with what probability that our decision may be wrong, the researcher did not calculate the probability of type II error

$$\beta = P(\text{type II error}) = P(\text{non rejection of } H_0 \mid \text{true } H_1).$$

In other words, emphasis has been put on the "protection" from type I error and no attention has been paid to the type II error, namely the error effected when we fail to reject H_0 while H_1 is true.

The probability, $1-\beta$, is called power of control or more precisely power function of control. Greater power means greater probability not to fail to reject the H_0 when H_1 is true (and consequently better control). (Damodar Gujarati, Essentials of Econometrics 1992)

4.5 Parametric and Non-Parametric Test

There are two types of statistical tests:

A. Parametric

B. Non- parametric

Many statistical tests are based on the assumption that the sample is derived from a population which follows normal distribution. These tests are called parametric. Examples parametric test is the t-test and analysis of variance (ANOVA).

The choice of a parametric test is preferred if the researcher is confident of the normal distribution of the sample (or at least approximate). Choosing a non-parametric test especially encouraged in cases where the population does not clearly follows the normal distribution or when several remarks considered "outliers" (too high or too low compared to the average).

If the sample is large but does not follow the normal distribution, then the central limit theorem ensures that parametric tests can export satisfactory results. The exact number of observations of a "large" sample, however, depends on the nature of the non-normal distribution. Except for cases where the distribution is found to be extremely peculiar, as per an informal rule the sample deems sufficient in order to implement parametric tests when there are at least 30 observations for each sample of the survey. If applied in large samples nonparametric test, then this option does not affect the validity of the results. However, non-parametric tests considered more "elastic" and less dynamic (powerful) compared to parametric tests

If small samples are chosen for a parametric test, then the central limit theorem does not guarantee the validity of results. Therefore, the p-value may be inaccurate. If small samples follow the normal distribution applied in parametric tests, then there is a possibility that the p-value would be very high. There is a serious lack of capacity of non-parametric tests on small samples normally distributed. Proper selection of a statistical test is the most important decision in order to draw correct and valid conclusions on the market research

PART III

CHAPTER 5: FRAMEWORK OF EMPIRICAL RESEARCH

5.1 Empirical research on the returns of EU Banks following the announcement of the 2014 stress tests results

Event Assessment: Results of 2014 EU - wide stress test

(www.eba.europa.eu-wide-stress-testing /2014)

The results of present study are based on the evaluation of a sample with common features. The sample constitutes of financial institutions which are active in regulated markets and within the same business sector (European Union), they are established in countries with common currency; for the sample under evaluation common rule and common evaluation criteria (stress test of European Markets) have been set.

In order to achieve the evaluation of the total sample with universal criteria there has been a need to choose an event which fully affected the whole sector; this event has been the Announcement of stress tests results regarding the capital adequacy of financial institutions. This type of information has negative consequences in the performance of institutions under evaluation; these negative consequences may create unexpected returns at the announcement date in the market.

The Key element of basic assumption of empirical study is that assessment completed under of common rules and common evaluation criteria, in order to ensure the robustness and the effect of sample assessment. This empirical study aims to analyze the findings or otherwise the analysis of unexpected returns which shows up in prices of shares by an event which disturbs their expected performance. Many researchers involving abnormal returns consists of tests of the efficient markets hypothesis that share prices reflects all available information , so there is no way greater
(or less than) normal returns could earned expect by change (Armitage , 1995)

Stress tests as evaluation and selection criteria maintain the characteristics which allow us to evaluate a sector bank shares of European industry with uniform rules and criteria in accordance with their ideological rules as discussed below.

The choice of empirical studies sector is bank shares of European sector and the assessment event is the results of these stress tests. The reference point is the result of the stress tests and the announcement of the need to strengthen their capital adequacy (increase in share capital). An item of information which universally affected the whole sector at the announcement date and contingent has created unexpected yields.

Results of research can show the correlation of the shares and how they react to the event which affects their performance (how the shareholders react to adverse scenario which increased capital adequacy).

At this point it should be reminded that stress tests regarding of banks in the supervision and control through a single mechanism of the European Central Bank took place in 2009,2010,2011,2014 and 2016.

Rational choice of evaluation year is the test which carried out in the year 2014 because the previous evaluation took place in 2011 and the next in 2016 so the market did not maintain prior information that affects the performance in an interval of two years (Ikenberry, Lakonishok and Vermaelen ,1995).

Taking for granted the uniform action of stress tests rules which aim to the universal evaluation of bank shares we are given the opportunity to assess unexpected performances arising out of the announcement regarding capital adequacy of financial insitutions which failed to pass stress tests.

Furthermore, we are given the possibility to compare the stock performance of those who required the increase of the capital adequacy in relation to the control portfolio of stocks (benchmark) which include share not requiring strengthening their capital adequacy. An announcement which not channeled in the market information where directly affects their performance and create unexpected returns.

On the basis of the main idea that has been mentioned above a catholic sample evaluation has been carried out with common and uniform rules and the selection of the selecting an assessment year (Announcement date of results EU-wide stress test - 26/10/2014, Appendix Table C Results of 2014 EU – wide Stress test)

Assessment Period

Sample assessment: Share which include in stress test of 2014 (EBA 2014 EU-Wide stress)

Pre Event Period: 1/1/2012 to 24/10/2014

Event Window : 26/10/2014 (Public of research)

Post Event Period: 31/10/2014 to 25/12/2015

Returns: Weekly Returns of shares

In the Empirical analysis the following evaluation methods were used: CAPM, BHAR, WR as well BHAR" and PBHAR which reassessed the reference portfolio by calculating weekly average returns of reference shares. Developed scientific research applied to the Article of Erasmo Giambona Carmelo Giaccotto and c F Sirmans.

During present research for finding data from banking shares it has been noticed that a large number of share are not traded in organized market which makes it impossible to assess the performance of common criteria in relation to the number of Bank shares traded in an organized market.

Extracts data from Datastream and Elliot system for 55 Financial institutions of which rejecting the financial institutions with foreign exchange exposure ended in

39 shares. Finally, I collected and created a group of 23 shares as reference Portfolio (does not required strengthening their capital adequacy) and a group of 16 shares in need of strengthening their capital adequacy.

Figure 11

Delineating of rules during the empirical analysis

The sample contains same currency banking institutions in order to avoid the effect on performance of the exchange rate.

As a benchmark I created a control portfolio of stock from same sector which during the assessment their not required a reinforcement if the balance it (do not transferred information in the market that creates commotion in their performance).

In order to reduce the phenomenon of autocorrelation and the turbulence generated and to strengthen our sample, we did not include in the evaluation of the shares which showed the need to raise capital within two years of the survey year assessment (10/2014); in addition the control portfolio did not include the shares which had shown the need to increase within two years from the date of announcement of research 10/2014 (Ikenberry, Lakonishok and Vermaelen ,1995).

Using a control sample from the same industry should drastically reduce the bad model problem because, under the null hypothesis of no abnormal returns, average returns for event firms should not be different from returns for the reference portfolio (Erasmo Giambona, Carmelo Giaccotto and C.F. Sirmans, 2005)

5.2 The concept of European Union- wide Stress Test 2014

The process of stress tests involves the identification of principal risks and key vulnerabilities of the financial system, the choice of potential, negative scenarios which disrupt the stability of the system, the design and evaluation of the results arised from the above hypothetical shocks (advesre scenario) to select the appropriate policies for each bank.

The bank stress tests are simulations of future adverse, economic events designed to assess whether a bank or a financial institution has the necessary adequate funds to cope with the adverse and unexpected developments in the economy.

The stress tests simulations are an important risk management tool for the banks, because they warn for any negative unforeseen consequences, so that they get prepared to face them. They also facilitate the planning of capital and liquidity, give a clear picture of the sensitivity of a portfolio to the risk; in addition the potential loss in a hypothetical crisis scenario is determined.

The stress tests are carried out by supervisory authorities in order to assess the extent that the financial system may be affected in the case of a possible financial crisis.
The stress tests aim to investigate the impacts on the value of the portfolio securities, if there are changes to specific factors. Potential changes are not common to happen, but no scenario should be excluded. At the same time, the supervisory mechanism (European Banking Authority) determines the amount of capital which is necessary so as to absorb the losses that would result if these potential scenarios would occur.

The scenarios except of extreme cases, must also be realistic and in no case should be considered as forecasts of the banks.

The scenarios of stress tests carried out in 2014 each covered a period of three years (2014-2015). The baseline scenario is based on the macroeconomic growth forecast according to the European Commission whereas the adverse scenario describes a hypothetical worldwide recession (EBA, 2014).

The stress test relied on a static balance sheet assumption implying no new growth and a constant mix and model over the whole time horizon. (EBA, 2014).

Whether bank passed the stress test was determined according to the resulting Common Equity Tier 1 (CET1) ratio under the baseline and adverse scenario. The definition of Common Equity Tier 1 (CET1) of the CRR/CRD IV(ie the implementation of Basel III in the EU) was applied. In order to pass the stress test, banks needed to clear the CET(1) hurdle rates of 8% in the baseline scenario and 5,5% in the adverse scenario (European Banking Authority 2014 EU-Wide stress testing). (EBA, 2014).

The framework of stress test provided competent authorities with a common set of tools, including a common methodology, an internally consistent but relevant scenario and a set of templates to capture starting point data and stress test results to allow a rigorous assessment of banks resilience under stress. The common methodology defines how banks should calculate the stress impact of the common scenario bottom – up and at the same time sets constraints for their calculation. Along with the templates, it also ensures that the stress test results can be effectively disseminated in a transparent and comparable fashion at and European Union level. (EBA, 2014).

The EU- Wide stress test is designed to provide supervisors, banks and other market participants with a common analytical framework to consistently compare and contrast the resilience of European banks under adverse market conditions, under common macroeconomic scenarios

5.2.1 Risk Coverage policy of capital adequacy

According to European Banking Authority the objective of the European Union- wide stress test is to assess the resilience of banks contributing to understanding systematic risk in the European Union and fostering market discipline. The EU- wide stress test was primarily focused on the assessment of the impact of risk drivers on the solvency of banks. Following risk categories have been taken into account in order to evaluate the effect on banks balance sheet:

- Credit Risk
- Market Risk
- Sovereign Risk
- Securitization Risk
- Cost of funding and interest income

The exercise used macroeconomic scenarios, which include deterioration in key macroeconomic variables, cuts in state and bank portfolios, forecasts of high risk, unfavorable changes in interest rates and spreads, in order to reflect the increase in risk premia, which is linked to the deterioration of the markets of European Union government bonds. Furthermore, the requirements set by the banks against governments will be treated in the same way as the other loan portfolios. The evaluation of creditworthiness of financial institutions is carried out via capital adequacy index.

Although the focus of the exercise remained on credit and market risk banks were also requested to assess the impact on interest income, including the increase in the cost of funding, over the stress test time horizon. Capital requirements for operating risk were also taken into account with operation risk costs. The baseline scenario was provided by the European Commission based on the winter forecast by extended by one year. The adverse scenario provided forward – looking paths for key macroeconomic and financial variables for all EU countries and a large number of non European countries which include in sample assessment. (EBA, 2014).

Figure 12

Adverse Scenario of EU-wide Stress Test 2014

1. Increasing Global performance of bonds boosted by a sharp reversal in the assessment of risks especially to emerging markets
2. Deteriorating credit quality in countries with weak demand
3. Assessment of political risk (Stagnation of reforms put at risk confidence of public finance)
4. Increased costs of financial banks / Charge balance sheet and Public affordable financing market
5. Worsening indicators (Real Estates , GDP , Unemployment), Pressures on the balance sheets due to unfavorable scenarios in extreme scenarios exchange rates

5.2.2 Monitoring mechanisms for the evaluation of EU Stress Test 2014

The European Union – wide stress test is coordinated by the European Banking Authority (EBA) across the European Union and is carried out in cooperation with the European Systematic Risk Board (ESRB) , European Commission, European Central Bank (ECB) as well as competent authorities from all relevant national Jurisdictions. (EBA, 2014).

The EU-wide stress simulation was based on an adverse macroeconomic scenario provided by the European Central Bank in close cooperation with national competent authorities. The adverse scenario envisages future paths for key macroeconomic variables for all countries of the EU and a large number of countries that are not in the European Union (EBA, 2014).

Above authorities use stress tests as a tool for monitoring the soundness of the credit system, the taking of preventive measures on time, the planning and allocation of capital. Furtermore, except for supervisory purposes, stress tests are used as a tool for assessing the durability and stability of the European banking system under extreme adverse conditions. They aim to assess the strength and creditwirthiness of European banks in potential, extreme situations under certain restrictive conditions taking into account extreme macroeconomic phenomena designated by the European Central Bank.

The European Banking Authority (EBA): Developed the common methodology and ensured a consistent and comprehensive disclosure of results. EBA assisted by providing sets of statistical benchmarks to all competent authorities as a tool to assess the banks results

The European Systemic Risk Board (ESRB) and European Commission: Provide the underlying macroeconomic scenarios; competent authorities including the European Central Bank were responsible for the quality assurance of banks results as well as for the asset quality reviews informing the starting point of the stress test. They are also responsible for the deciding on follow up actions in the supervisory reaction function.

The process for running the common EU-wide stress test has been involved in close cooperation between EBA, competent authorities from all relevant jurisdictions, the ECB the ESRB as well as the European Commission. Competent authorities were responsible for conveying instructions on completing the exercise to banks and for receiving information directly from banks. supervisory mechanisms are also responsible for the process quality control and he communication of all follow up actions that will form the supervisory reaction function

5.2.3 Structure and Results of the EU-wide Stress Test 2014

In the bank stress test participated 123 banking groups from 22 countries covering more than 70% of total banking assets in the European Union. The sample was selected to cover at least 50% of the national banking sector, directly or via subsidiaries of parent companies included in the sample in each European Union member state and Norway. (EBA, 2014).

The European Union- wide stress test was conducted based on the assumption of a static balance sheet. A zero growth assumption was applied for both the baseline as well as the adverse scenario. Assets and liabilities that mature within the time horizon of the exercise were assumed to be replaced with similar financial instruments in terms of type, credit quality and maturity as at the start of the exercise.

Exemptions from the static balance sheet assumption were solely granted due the directions in mandatory restructuring plans that had been publicly announced before 31/12/2013. These restructuring plans needed to be formally agreed with the European Commission. 26 banks were exempted from the static balance sheet assumptions because of restructuring plans approved by the European Commission before this reference date. (EBA, 2014).

Dynamic Balance Sheet: 26 Financial Institutions

Static Balance Sheet: 97 Financial Institutions

As acceptable limits non requirement of additional capital adequacy set for A basic scenario Common Equity ¨Tier 1 8% and for the adverse scenario Common equity Tier 1 5,5%

Countries that have been included in the evaluation and number of institutions that participated in it

Austria (6) Belgium (5), Cyprus (3), Germany (24), Denmark (4), Spain (15), Finland (1), France (11), Greece (4), Ireland (3), Italy (15), Luxembourg (2), Latvia (1), Malta (1), Netherlands (6), Norway (1), Portugal (3), Poland (6), Sweden (4), Slovenia (3), United Kingdom (4).

Simulation test of capital adequacy of financial institutions shows that from 123 banking stocks 24 institutions failed to retain their Tier 1 common equity to acceptable threshold of 8% in basic scenario and 34 financial institutions failed to retain their Tier 1 common equity ratio to acceptable ratio of 5,5% of adverse scenario. (EBA, 2014).

Countries and number of institutions that participated in it which failed to score acceptable limits in basic scenario

Austria (3) , Cyprus (1), Germany (3), Denmark (4), Spain (1), France (1), Greece (3), Ireland, (3), Italy (8),Portugal (1).

Countries and number of institutions that participated in it which failed to score acceptable limits in adverse scenario

Austria (3), Belgium (2), Cyprus (3), Germany (4), Spain (1), Greece (4), Ireland (3) Italy (9), Netherlands (1), Norway (1), Portugal (2), Slovenia (2)

Results of 2014 European Union Wide stress test in Appendix , Table C

CHAPTER : 6 PRESENTATION OF SECURITIES PERFORMANCE VIA UNEXPECTED RETURNS

6.1 Evaluation of findings via method Capital Asset Pricing Model

CAPM is a measure model used in economic theory which describes relationship between risk and returns, or equivalently, it is a model for the pricing of risky securities. The CAPM assets that the only relevant risk that investors will require compensation for assuming is systematic risk because that risk cannot be eliminated by diversification. (*William F. Sharpe* το 1964)

The general idea behind CAPM is that investors need to be compensated in two ways: time value of money. The time value of money is represented by the risk-free (rf) rate in the formula and compensates the investors for placing money in any investment over a period of time. The other half of the formula represents risk and calculates the amount of compensation the investor needs for taking on additional risk.

The model is,

$$E(R_{it})=R_{ft}+\beta_i[E(R_{mt})-R_{ft}]$$

Where,

- $E(R_{it})$: is the expected or normal return on share i for time t
- R_{ft} : is some measure of the risk free rate of interest
- $E(R_{mt})$: is some measure of the expected return on the appropriate stock market

- β_i : is the covariance of R_{it} with R_{mt} over some estimation period divided by the variance of R_{mt} over that period

$$\beta_i = \frac{(cov(Rit,Rmt))}{(\sigma 2(Rmt))}$$

According to the theory, ex ante expected values of R_{mt} and β_{it} determine $E(R_{it})$, but ex post values are usually substituted as proxies. Beta is the model which measures the risk of the share. The abnormal return on share i for time t is calculated by subtracting the actual return, Ri , from the expected return $E(R_{it})$.

The ration behind the use of CAPM method is to present at macroeconomic level the negative effects on each financial institution which participated in the stress test, due to the announcement event regarding the capital adequacy in adverse scenarios.

The index Euro Stoxx 600, chosen as a reference benchmark and reflecting the returns of European market, gives us the opportunity to measure the disturbance of the event, by comparing the errors which created from CAPM formula in pre event period with the errors which created in post event period.

The idea is to measure the expected returns for each financial institution in post event period using the beta, which reflects the multiplier relation between risk and returns, recognized by the market until the date of the event. Shares expected return over a period is the return on the market over that period, often with an adjustment for the shares risk (Armitage , 1995).

The return of ten- year German Government Bond has been used as risk free rate.

Figure 13

Estimated Parameters that have been taken in to account for CAPM methods

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Sample assessment: Share which include in stress test of 2014 (EBA 2014 EU-Wide stress)

Data: 39 financial institutions which traded in organized markets of which 23 shares succeed the capital adequacy and 16 shares which failed to pass the adverse scenario and need strengthening their capital adequacy

Pre Event Period: 1/1/2012 to 24/10/2014

Event: 26/10/2014 (Public of research for Capital adequacy)

Post Event Period: 31/10/2014 to 25/12/2015

Returns: Weekly Returns of shares

Risk Free Rate: Returns of ten years Germany Government Bond.

Reference Benchmark: Weekly returns of Euro Stoxx 600

Proceeding to aggregation of results I created two group of stocks where the first group illustrates the results of banking stocks which successfully passed the stress tests, did not transferred information at the market which directly create turbulence in the stock performance and the second group which illustrate the results of banking stocks which failed to passed the stress test, an information which create commotion in their market, suddenly disturbances the relationship between risk and return of pricing risk security (Appendix , Table D Control Equity of Reference Portfolio and Table F Equities with restriction capital).

When it comes to the results analysis stage, it is interesting to present the turbulence of performances arisen from the announcement of results at a risk level as well as at performance level.

In the columns of Tables D and F ‘’Abnormal Return of Stress test Announcements using CAPM methods’’ they represent the difference of error for each one banking stocks which illustrate the distortions (shadowing) or else the difference in performance of each banking institution that participated in the evaluation test.

Announcement of the results at 26/10/2014 affect the performance of each share participated in the single and universal assessment system based on the difference of the errors which appears in columns. Represent the noise which produced via diversification of risk which market reacts of announcement event.

Proceeding in finding average of dispute errors per group and subtracting from the class of shares which successfully passed stress test the results of shares which transferred adverse news in the market, observed a difference at -0.014341 (Appendix, Table G) which in fact illustrates the volatility of the overall adverse group, the turmoil of the market or otherwise underperformance over all banks which needs to increase their capital adequacy in relation to the group of shares which not require to increase their capital adequacy , illustrates the underperformance of the assembly in market level.

Following the single evaluation mechanism (EU- wide stress test) and having in mind how market recognizes, responds and reflects the performance of the financial sector, important to note the following.

Before the announcement results of Stress test, the reliability as well as the proper risk-taking on the part of investors is reflected in equity returns but also in beta of each groups, a beta which highlights and reflects the multiplication of risk comparing with performance of the European market. In columns ‘’Beta Pre-Event Period’’ and ‘’Beta Post- Event Period ‘’ for each group represents the beta of stocks for each period and how market recognizes and readjusts the relationship between risk and

returns before and after announcement period. Notice that weighted average of control portfolio had multiplier performance (beta) of 0,9561 which after the evaluation and delivery of information, the market responded to single evaluation mechanism reflecting the aggregated multiplier of the control portfolio at 0,98483.

It is interesting to capture the behavior of investors in banking stocks were required to strengthen of their capital adequacy following the announcement of the assessment test.

It is noteworthy to mention that the market had been surveying in group of these shares weighted average multiplier performance (beta) 0,87175 where after the delivery information to the market (announcement of results) and the actions where required by the side of the market for rational assessment of risk, noted that the market acknowledged this universal assessment and readjusts of industry by leading the weighted average beta of shares at 0.98508 reaching the levels of control portfolio.

Testing the statistical significance of the non-expected performance that are created by the process of CAPM

Considering that the sample came from normally distributed population whose diaspora is unknown (William Sealy Gosset, 1908) and because the number of sample observations is lower than 30 (Pooled control portfolio contains 23 banks and grouped table the banking stocks which required strengthening their capital adequacy 16 observations) in order to check my hypothesis regarding the association of underperformance of data due to communication the results of the stress testing I will use the methods of t-student (Damodar Gujarati, 1992 Essentials of Econometrics p.84).

I Will go into statistical significance control of " Abnormal Return of Stress test Announcements'' and if this can be related with the fact of information which placed on the market, information about capital adequacy of financial institutions, from the announcement of the stress test results. Moving on control statistical significance testing of the sample created by the removal unexpected returns pareichthisan with the CAPM method before and after.

Student t – distribution is a member of a family of continuous probability that arises when estimating the mean of a normally distributed population in situations where the sample size is small and population standard deviation is unknown , This technique was discovered in 1908 from William Sealy Gosset (Hurst Simon ,2010 The Characteristic function of the student t- distribution)

Formulation of test statistic (Student t – distribution William Gosset , 1908):

$$t - \text{Statistic} = t_{AR} = \frac{Average\,(ARt)}{\sigma(ARt)/\sqrt{n}},$$

Initial hypothesis set: the difference of means μ from the Abnormal returns in the population should be zero"; alternative hypothesis set: "the difference should not be zero" or alternatively null hypothesis set: the independence of findings which cause unexpected returns and as alternative hypothesis set the dependence of created unexpected returns on the stress tests.

H_0: $\mu=0$

H_1 : $\mu\neq0$

Upon calculation of the P-Value as described in Appendix, Table G, it is then compared with the significance level $\alpha=0,05$

If $\alpha \geq$ P- Value then H_0 should be rejected

If $\alpha <$ P- Value then H_0 should not be rejected

Otherwise,

If t-statistic $\geq$ $t_{0.025}$ then H_0 should be rejected

If t-statistic $<$ $t_{0.025}$ then H_0 should not be rejected

Upon calculation of the t-statistic as described in Appendix, Table G the results should be then compared with the results of Appendix, Table H

For "Equities with restriction capital" we have

t-statistic=2.81574> $t_{0.025,15}$ = 2.131 and P-Value =0.01375

For "Equities with restriction capital" we have

t-statistic=2.81574> $t_{0.025,15}$ = 2.131 and P-Value =0.01375

From the control findings it has been found that the difference between the two means is statistically significant in the population for both observation categories. Proceeding with the rejection of null hypothesis at the significance level α=0,05, the fact of stress tests announcement has created dependent unexpected returns which have played significant role in the shares' returns.

Catholic assessment through a commonly accepted mechanism instrument which contains macroeconomic data, has as a result, universal recognition of estimation industry and recasts the performance of stocks which involved in the supervision of the European Central Bank and the balancing performance of multiplier industry by reproduce multiplier performance of shares which involved. A Reproduction process which balance the multiplier performance risk for each group reaching a common level. Perhaps this means that the markets discounted the smooth and successful implementation of procedures on the part of banks and their harmonization with the

procedures of new environment which they assess new limits between risk and returns.

The unexpected returns which estimated via the assessment method of CAPM our contingent shows the equalization of the reproductive performance of the industry in relation to the return on the market. It is negative because the unexpected stock returns with the obligation to strengthen their capital adequacy reformulated in the market reaching the proper performance level based on the characteristics of the sector following the same level of sensitivity due to harmonization with new environment (capital adequacy valuation process) ,which now maintaining the characteristics of the entire sector risk.

6.2 Assessment of reproduced performances via the technique Buy and Hold Abnormal Returns

A large number of papers in finance literature have documented evidence that firms earn abnormal returns over a long time period (ranging from one to five years) after certain corporate events. Approximately 200 out of the 565 event studies use a maximum window length of 12 months or more (Ang and Zhang, 2011).

Several simulation studies such as Kothari and Warner (1997) and Barber and Lyon (1997) document evidence that statistical inference in long horizon event studies is sensitive to the choice of methodology. Long run AR are subject to additional problems which violate the assumptions of various econometric tests used to examine the statistical significance of AR e.g new listing bias, rebalancing bias , survivorship bias , violation of the normality assumption (Dionysia Dionysiou Journal of Economic Surveys 2014).

Barber and Lyon (1997) and Kothari and Warner (1997) advocate the use of a single-control firm as a benchmark because reference portfolios introduce new-listing, rebalancing and skewness bias in the calculation of BHARs. However, Lyon , Barber and Tsai (1999) point out that “carefully constructed reference portfolios

overcome these sources of bias and smooth out the measurement noise related to the use of a single- control firm".

Therefore, it is crucial to gain an understanding of the properties and limitations of the available approaches before choosing a methodology for a long-horizon event study.

At the core of any long horizon event study lies two tasks

A. to measure the event-related long horizon abnormal returns (model power)
B. to test the null hypothesis that the distribution of these long abnormal returns concentrates around zero (Power of test which measure AR statistical significance).

A proper testing procedure for long-horizon event studies has to do both tasks well. Otherwise, two types of error could be committed and lead to incorrect inference (An Evaluation of Testing Procedures for Long Horizon Event Studies James S. ANG Shaojun Zhang 2004).

The first error arises when the null hypothesis is rejected (type I error), not because the event has generated true abnormal returns, but because a biased benchmark has been used to measure abnormal returns. A biased benchmark shifts the concentration of abnormal returns away from zero and leads to false rejection of the null hypothesis.

The second error is committed when the null hypothesis is accepted (type II error), not because the event has no impact, but because the test itself does not have enough power to statistically discriminate the mean abnormal return from zero. A test of low power is undesirable, as it will lead researchers to conclude many significant events as statistically insignificant and thus make wrong conclusions from empirical evidence (Seth Armitage , Event Study Methods and Evidence on their Performance . Journal of Economics 1995) .

One possible strategy to counteract this long litany of problems is to test the statistical significance of post event abnormal returns with three difference statistics (methods of Erasmo Giambona , Carmelo Giaccoto and C.F. Sirmans):

a) Buy and hold abnormal returns (BHARs).

b) Wealth relative ratios (WR) proposed by Ritter 1991 and

c) A Percentage buy and hold abnormal returns (PBHARs) proposed by Erasmo Giambona, Carmelo Giaccotto and C.F Sirmans

BHAR is defined as the difference between the long run holding period return of a sample firm and that of some benchmark asset. Mitchell and Stafford (2000) explain BHAR returns as the average multiyear return from a strategy of investing in all firms that complete an event and selling at the end of a pre-specified holding period versus a comparable strategy using otherwise similar nonevent firms.

BHARs are computed as the difference between the sample firms buy and hold returns and its computed expected return under the null hypothesis. The main difference of BHAR compared to alternative estimating methods was the periodical compounding which taken to account for each firm and for whole period testing (Dionysia Dionysiou Journal of Economic Surveys 2014) for this reason , BHAR is considered “more realistic then other approaches” (Loughran and Ritter , 1997).

Both Ikenberry t al (1995) and Lyon et al. (1999) advocate that BHAR approach can avoid the skewness bias with careful benchmark portfolio formation and that normality assumption can be corrected via bootstrapping.

The model is,

BHARi=$\prod_{t=1}^{T}(1+rit) - E(\prod_{t=1}^{T}(1+rit))$

Where,

- T : is the number of months after the announcement over which to measure the BHAR,
- r_{it} :is the return of firm I in month t
- E (*): is its expected return under the null of no abnormal performance.

Hence, we use the idea of reference portfolio as a proxy for the expected holding period return E ($\prod_{t=1}^{T}(1+rit)$. The long horizon buy and hold return for the reference portfolio (BHRrp) for event firm is obtained by compounding the returns of security.

Typically, this expected return is approximated by a reference portfolio or some benchmark, in or estimation as benchmark we use the average returns of control portfolio of financial institutions which represent the returns of industry or else the reference yield of industry which not distrust their performance directly from public information of stress test. Based on the intuition of using an appropriate benchmark which include single non event matching firm with similar to the event pre event risk factor characteristics (Ikenberry et al 1995, Barber and Lyon 1997, Lyon et al 1999).

Using a control sample from the same industry should drastically reduce the bad model problem because , under the null hypothesis of no abnormal returns , average

returns for event firms should not be different from returns for the reference portfolios. (Giambona, Carmelo & Sirmans, 2005 p. 363)

Using the method of Buy and Hold in fact we try to capture at level of financial industry the biases of abnormal returns, an action which created from the fact of announcement event. The differentiation in relation to CAPM methods lies in that CAPM as econometric model measure the performance and expected return of shares at market level while the method of Buy and Hold substance displays the relationship between shares at sectoral level. Shows the rate of diversification in industry level. Barber and Lyon argue that "using average BHAR is advisable because if precisely measures investor experience over a particular time horizon"

Figure 14

Estimated Parameters that have been taken in to account for BHAR methods

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Sample assessment: Share which include in stress test of 2014 (EBA 2014 EU-Wide stress)

Data: 39 financial institutions which traded in organized markets of which 23 shares succeed the capital adequacy and 16 shares which failed to pass the adverse scenario and need strengthening their capital adequacy

Pre Event Period: 30/08/2013 to 24/10/2014

Event: 26/10/2014 (Public of research for Capital adequacy)

Post Event Period: 31/10/2014 to 25/12/2015

Returns: Weekly Returns of shares

Reference Benchmark: 23 Financial Institutions which succeed the Stress Test

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The idea is to measure for each period the expected computed average returns using as reference a portfolio (control portfolio) which includes financial institutions which maintain the same characteristics of industry over time, retains the same characteristics because they do not disturb the reference yield by adverse information which disturb the reference odds

The long horizon buy and hold return for the reference portfolio for event firm is obtained by compounding the returns of securities constituting the reference portfolio and then taking the simple arithmetic average of these returns (Giambona , Giaccotto and Sirmans ,2005)

The model is,

$$BHR_{RPi} = \sum_{j=1}^{n1i} \frac{[\Pi]_{t=1}^{T}(1+rij)]}{n1i}$$

Where n_i is the number of firms in the reference portfolio for firm i in month 1 (i.e., the weekly returns) and r_{jt} is the market return of firm j in weekly returns.

Actually we create a constant reference point of control benchmark which permitted us to capture the disruption between shares and reference point, for periods before and after the announcement event. Shares of financial institutions which disrupt their performance as a results of adverse assessment (bad news) which diffusion in the market.

Progressing to aggregation of results in tables (Appendix, Table D and E) "Control Equity of Reference Portfolio" and "Equities with restriction capital" displays the results (computed returns) for each included stock for both periods before and after the event. Analyzing the results which include at reference portfolio "Control Equity of Reference Portfolio" we found that expected computed average returns for pre event period was 1,1133 and for post event period was 0,9907 (The variation

between average expected returns for each periods may reflect the indirect effect of industry from the assessment of stress test).

More over at table "Equities with restriction capital" in columns '' BHAR Pre event Period'' and '' BHAR Post Event Period'' reflects the stock performance (BHAR) per period over reference benchmark. Until the date of public information (announcement results of stress test ,24/10/2014) the profitability of shares that in the end required the strengthening of their capital adequacy underperformed by 2,10% via reference benchmark, where after the challenging of information, the returns where redefine their underperformance at 32% (Table F).

During constant assessment between actually returns and reference benchmark its permit us to capture for each shares from adverse scenario the influence which produce the type of information in their achievement by subtracting the evidence from pre event period (actually computed returns per share minus reference computed returns) the evidence of post event period. Hence we capture the disturbance which reflected in table Control Equity of Reference Portfolio in column "Disturbance of achievement''. A disturbance which depicted the quantitative adjustments of abnormal returns per 29,89%(Table F)..

Moving on statistical significance of null hypothesis we estimate the significance of test using student-t test which used in study of Giambota, Giaccotto and Sirmans , 2005.

Formulation of test statistic (Student t – distribution William Gosset , 1908):

$$t_{BHAR} = \frac{Average\,(BHARt)}{\sigma(BHAPt)/\sqrt{n}}$$

Where Average ($BHAR_T$) is the sample average buy and hold abnormal return, $\sigma(BHAR_T)$ is the cross sectional sample standard deviation and n is the total number

of event firms. The ratio t_{BHAR} should behave like a student's t statistic (Barber abd Lyon 1997).

Proceeding with the statistical significance control of the findings evidenced by created of methodology "BHAR for each pre event and post event period" it has been attempted to detect their power; more specifically, it has been attempted to describe on the one hand the relation of findings with the unexpected returns (dependent or independent variables) or on the other hand the correlation with the Event. In the latter case, namely if the returns depend on the Event, the null hypothesis is actually rejected.

The method to be used will be t statistic which has been also applied in the research conducted by Giambotta Giaccotto and Sirmans, 2005. This method will show if and to what extent the returns have been influenced by the Event (if the information given to the market creates returns and to what extent these returns may be significantly linked to the Event).

T statistic findings: Appendix, Table G

Setting the independence of findings as null hypothesis and the rejection of null hypothesis (dependence) as alternative hypothesis at level of significance α=0,05%, we proceeded to a two-tailed test of values.

Initial hypothesis set: the difference of means μ from the Abnormal returns in the population should be zero"; alternative hypothesis set: "the difference should not be zero" or alternatively null hypothesis set: the independence of findings which cause unexpected returns and as alternative hypothesis set the dependence of created unexpected returns on the stress tests.

H_0: $\mu=0$

H_1 : $\mu\neq0$

Upon calculation of the P-Value as described in Appendix Table it should be then compared with the significance level $\alpha=0,05$

If $\alpha \geq$ P- Value then H_0 should be rejected

If $\alpha <$ P- Value then H_0 should not be rejected

Otherwise,

If t-statistic $\geq t_{0.025}$ then H_0 should be rejected

If t-statistic $< t_{0.025}$ then H_0 should not be rejected

Upon checking the two periods, before and after the Event, followings data have been drawn: p value: 0,8559 for pre event period and p value: 0,0275 for post event period. In addition t-statistic for " BHAR pre event period: -0,3754 and t-statistic for "BHAR Post event Period" : -2,4405

For the pre event period

$\alpha= 0,05\geq$ P- Value $= 0,8559$

For the Post event Period

$\alpha = 0,05 \geq$ P- Value $= 0.0275$

Results (Appendix , Table G)

Under the term P value it is expressed how likely is the appearance of an extreme or even more extreme sample than the one appeared, given that H_0 applies. In general, if p value is close to 0, then it is concluded that it is impossible, due to the H_0, that this sample would appear and consequently it is concluded that H_0 would not apply (Hubbard R, 2004)

It may be noted that at the statistical significance level $\alpha=0,05$ for the results of pre event period, the null hypothesis should not be rejected due to the fact that there is not statistical significance among the findings. The announcement of the results regarding the banks' capitals adequacy led to a market turbulence. It has been noted that following this market turbulence the shares of banks which required the boost of their capital adequacy in relation to the portfolio control let to underperformance of 32% which is actually associated with the stress test event with level of statistical significance $\alpha=0,05$. It is obvious that the market reacted to the information by causing underperformance due to the event.

Following the stress tests the market has been informed about the credit structure of bank institutions. The announcement of stress tests results led to the underperformance of shares, showing the need of boosting their capital adequacy; due to statistical significance this underperformance is also expressed by the tendency of the investors to sell the shares which need capital reinforcement or by a win- win relation risk and performance. If the market has anticipated the smooth capitalization of the banking system, this would probably create a statistical significant control which would not be able to reject the null hypothesis.

At a macroeconomic level, via the method CAPM the control is evaluated in terms of performances restructure and smoothing the risk against the performance, while in case of control within the sector, what should be noted is the risk aversion and the

statistical significance which follow the announcement. The intense underperformance of bank shares in comparison with the control portfolio as well as the strong statistical significance of performance following the announcement provide with evidences that the underperformance is linked with the evaluation test and the restructure of the system led to underperformances which demonstrate the risk aversion of investors from the financial institutions with need of capital reinforcement.

6.3 Assessment of reproduced performances via the technique Wealth Relative Ratios

The findings following the use above 2 methods Buy and Hold και CAPM are also confirmed by the use of method Wealth Relative.

The method Wealth Relative has been first used by Jay R Ritter in 1991 in order to evaluate the performances of IPOs and the reaction of shares in a period of three years (Journal of Finance , Jay R. Ritter, 1991).

The model under estimation which has been used in the empirical analysis has been the outcome of the empirical research conducted by Erasmo Giambona, Carmelo Giaccotto and C.F. Sirmans, which is,

$$WRi=\frac{\prod_{t=1}^{T}(1+rit)}{BHRrpi}$$

Where basically for the two periods before and after the announcement of the stress tests results we divided the average custom multiplicand held-performance Π(1 + ri) of the group of shares which finally required boost of their capital adequacy (Appendix, Table E) with the average of the reference sample (custom multiplicand held-performance control portfolio of the relevant period, (Appendix, Table D,)

The results are presented in the table Assessment Methodologies Estimating Abnormal Returns (Appendix , Table F).

According to Ritter if the result is greater than one (1) then it should be mean that the estimated group which contains the shares with the need to strengthen their capital adequacy outperformed in comparison with the benchmark index (Control portfolio); if the result is less than one (1) then the result should be interpreted as underperformance of the estimated group compared to the benchmark (Journal of Finance, Jay R. Ritter, the Long Run Performance of initial Public Offering .p.8)

In Table E columns WR Pre Event Period and Post Event Period show up the achievements for its share in relation with control portfolio for its periods

For the pre event period the underperformance is 0,9811 and it is noted that following the bad announcement the underperformance is 0,6770 (Appendix , Table F). Upon deduction of the results of two periods the underperformance found is -0,3040.

The announcement of stress tests results had the following consequence: the unexpected performance channeled to the market had an impact of -0,3040 in the performance of shares with need of strengthening their capital adequacy against the sector (benchmark index). The underperformance shows the level of achievement at a sector level and not at the level of total market performances.

6.4 Assessment of reproduced performances via the technique Percentage Buy and Hold Abnormal Returns (PBHARi)

The above method has been used following the scientific method applied in the paper The Long Run Performance of REITS Stock Repurchase of Erasmo Giambona , Carmelo Giaccotto and C.F. Sirmans.

This methodology can capture the autocorrelation of returns into long horizon buy and hold abnormal return estimators. Serial correlation can introduce autocorrelation bias for simple firms and non simple firms in different fashion which may leads to rejection of a true null hypothesis of no abnormal performance more often than the prespecified significance level ''(Erasmo Giambona , Carmelo Giaccotto and C.F. Sirmans, 2005)

Considering that the findings via method WR do not isolate the weekly autocorrelation of observations per bank share but they permit the aggregation of bias in weekly observations (distortion of results due to the autocorrelation of observations and transmission to the weekly observations), we proceeded to the weekly research of average performance of reference portfolio according to the type:

$$\text{PBHARi} = \frac{\prod_{t=1}^{T}(1+rit)}{\prod_{t=1}^{T}(1+rbt)}$$

Where,

- r_{it} = is the firm i return in weekly return t
- $r_{bt} = \frac{\sum_{j=1}^{nj} rjt}{nj}$ is the reference portfolio return in weekly return t and T is the number of weeks for periods before and after the announcement.

In addition, the calculation rationale has been followed based on the same implementation method as in the method Wealth Relative that has been above developed; the salient different lays in the way of calculating the reference portfolio (control portfolio).

In practical terms, we didn't proceed with finding the average of the adjusted multiplier the held value of the control portfolio throughout the period for pre event period and post event period but the weekly average valuation adjusted the held value of the control portfolio for pre event period and post event period and we found the weekly deviation for each share which needed to strengthen its capital adequacy in relation to the weekly achievement level of benchmark (control portfolio).

Via said method and upon isolation of bias of results, we found for each financial company with need of strengthening its capital adequacy the percentage of underperformance or outperformance against the reference portfolio for pre event period (Appendix , Table E column PBHARi Pre event Period) and post event period (, Table E column PBHARi Post Event Period)

According to the method PBHAR for the pre event period the underperformance is 0,9613 and following the bad announcement the underperformance is 0,6787 (Appendix , Table F).

The announcement of stress tests results had the following consequence: the unexpected performance channeled to the market had an impact of -0,2826, Appendix Table F in the performance of shares with need of strengthening their capital adequacy against the sector (benchmark index). The underperformance shows the level of achievement at a sector level and not at the level of total market performances.

It is important to note that in the Table I it is also shown the bias produced due to the autocorrelation which has been isolated via the method PBHARi and shows the distortion of results per share throughout pre event period and post event period.

6.5 Assessment of reproduced performances via the technique Buy and Hold Abnormal Returns* (BHAR*)

We followed the aforementioned method regarding the calculation of BHAR with the differentiation mentioned above regarding the reference portfolio used in the method PBHARi.

By calculating the weekly average multiplicand valuation of the reference portfolio (isolating the bias of results due to autocorrelation of the observations) it has been attempted to demonstrate the underperformance of shares with need to strengthen their capital adequacy against the sector (control portfolio) and not in the overall market for pre event period to - 4.39% and post event period -31,75% having a different charge or unexpected performance of the information placed on the market -27.36% as shown in Table F.

CHAPTER 7

CONCLUSIONS

The purpose of present paper was the description of main methods and tools used in order to evaluate the overreturn which appears as abnormal return due to events that have impact on firm value. The principle of the "return valuation model" is that the return should fully reflect the risk undertaken by an investor.

The attempt to evaluate the overreturn actually highlights the facts and difficulties that may arise and will result to false evaluation of the results. A part from the main factor which may contribute to drawing reliable conclusions, namely the choice of the "right/ correct" valuation model, it is also important to include the right variables in the model in order to have the most representative sample of remarks.

Finally, it should be pointed out that with view to achieving a high representation grade in terms of market return, a great variety of techniques and description methods has been used. Bibliography references vary from the simplest version of evaluation model "index model" to the most complicated version by using multi-factor models and "momentum factors".

Main categorization and grouping parameter of various techniques is the event period. The most widely used evaluation methodology is the "Long Horizon" with an up to 12 months event period. By using this method an in-depth analysis of the impacts of unexpected events is possible. Main concern of the researchers is how to tackle the issues of cross correlation, autocorrelation and the maintenance of estimated remarks which may overestimate or underestimate the return value especially when events appear at least twice during an event period.

Two methodologies have been developed in order to better face the challenge of right long horizon, Calendar Time and Buy & Hold, each of them having advantages and disadvantages. The incorrect assessment may result to the rejection of the null hypothesis and non acceptance of statistical significance of the evaluation model.

Main condition for the effectiveness assessment of the remarks is the acceptance of the “effective” market and the assumption that the stock prices adapt promptly to all the new data that arise; it practically means that the stock prices actually reflect the publicly available information (semi strong market hypothesis).

Relying on the above hypotheses proceeded to selection of an event that is capable of affecting the expected return of shares. This is the assessment test regarding the credit rating of the banking system through adverse scenarios laid down by the European Central Bank. A mechanism whose characteristics ensure the homogeneous and comprehensive evaluation of financial institutions which are included in the single evaluation mechanism. Peculiatities and evaluation criteria of stress tests have been elaborated throughout the Empirical Research.

In order to detect the effects generated by the announcement of the results, two types of estimating methods were used. The first one detected at macroeconomic level (market level) the turbulence which is caused in the banking industry in terms of unexpected performance and risk (beta) and the second category at sector level the distortion arisen between the involved shares.

Following the stress tests the market has been informed about the credit structure of bank institutions. The announcement of stress tests results led to the underperformance of shares, showing the need of boosting their capital adequacy; due to statistical significance this underperformance is also expressed by the tendency of the investors to sell the shares which need capital reinforcement or by a win- win relation risk and performance. If the market has anticipated the smooth capitalization of the banking system, this would probably create a statistical significant control which would not be able to reject the null hypothesis.

At a macroeconomic level, via the method CAPM the control is evaluated in terms of performances restructure and smoothing the risk against the performance, while in case of control within the sector, what should be noted is the risk aversion and the statistical significance which follow the announcement.

The intense underperformance of bank shares in comparison with the control portfolio as well as the strong statistical significance of performance following the announcement provide with evidences that the underperformance is linked with the evaluation test and the restructure of the system led to underperformances which demonstrate the risk aversion of investors from the financial institutions with need of capital reinforcement.

Appendix

Table A. Techniques of measuring event studies of corporate events

Table B. Techniques of control heteroskedasticity and autocorrelation

Table C. Results of 2014 EU-Wide stress test

Table D. Control Equity of Reference Portfolio

Table E. Equity with Restriction Capital

Table F. Assessment Methodologies Estimating Abnormal Returns

Table G. T –student test

Table H. Table of Critical values for student t Distribution

Table I. Biases which prodeceed via autocorrelation and serial correlation

Table A.

Techniques of measuring event studies of corporate events

Authors	Corporate Event	Market	Benchmark/AR calculation method/Other controls	Test of statistical inference
Ahmad- Zaluki et al. (2011)	IPO	Malaysia	1. Market-adjusted/BHAR/ew 2.Matching firms (industry + operating performance +assets size)/BHAR/ew	1.Mann-Whitney U test (sub-sample median comparisons)
He et al. (2010)	Private placements	Japan	1.Matching firms (size + industry+BTM)/BAHR/ew	1. Traditional t-statistic
Wruck and Wu (2009)	Private placements	US	1. Market adjusted/CAR/ew 2. Matching firms (size +industry+BTM+momentum)/CAR/ew 3. Carhart - 4factor model /CTAR/ew, vw	1. Traditional t-statistic
Iqbal et al. (2009)	Open offers	UK	1. Market -adjusted/BHAR,WR/ew 2. FF-3factormodel/CAR/ew 3. Carhart-4 factor model/CTAR/ew	1. Skewness - adjusted t-test 2. Crude dependence-adjusted t-test for CAR FF-3factor (Brown and Warner, 1980)
Ngatuni et al. (2007)	Rights issues and Open Offers	UK	1. Matching firms (size, size+ industry, size+ BTM) /BHAR /ew	1.Traditional t-statistic 2. Z-test (for the negative BHAR) 3. Wilcoxon test
Eckbo et al. (2007)	IPO, SEO	US	1. Matching firms (size+ BTM) / BHAR / ew, vw 2. FF-3factormodel/CTAR/ew 3. FF- 5 factor model (Eckbo and Nornli, 2005) / CTAR / ew	1. T-tests 2. White corrected t-statistic (for CTAR)

Armitage (2007)	Right Issues	UK	1. Matching firms (size, size+industry, size+BTM) / BHAR / ew	1. Traditional t-statistic 2. Non- parametric Wilcoxon paired test
Yan-Leung and Liu (2007)	IPO	Hong Kong	1. Market-adjusted/BHAR/ew	1. Traditional t-statistic
How et al. (2007)	IPO	Malaysia	1. Market-adjusted/BHAR, CAR/ ew, vw	1. Traditional t-statistic
Pastor - Llorca and Poveda- Fuentes (2006)	IPO	Spain	1. Market- Adjusted (index)/ BHAR / vw	1. Bootstrap procedure
			2. FF-3factor model / CTAR / ew	2. Skewness-adjusted t- statistic (Johnson, 1978) 3. White corrected t-test (for CTAR)
Li and Zhao (2006)	SEO	US	1. FF-3factor /CTAR/ ew	1. Skewness - adjusted t-test
			2. Matching firms (size +BTM, size+BTM+past returns) / BHAR / ew	2. Bootstrapped standard errors (Lyon et al., 1999)
Peyer and Vermaelen (2005)	Private repurchase	US	1. FF-3factor model / CAR, CTAR /ew factors but vw market index	1. T-test (time -series variation of portfolio AR)
Krishnamurthy et al. (2005)	Private placements	US	1. Matching firms (size, BTM, size+ BTM, size+ BTM+ placement choice) / BHAR, WR / ew, vw	1. Wilcoxon test 2. Traditional t-statistic 3. Z- statistic
			2. FF- 3 factor model / CTAR / ew, vw	
			3. Carhart- 4factor model / CTAR / ew, vw	
Eckbo and Norli (2005)	IPO	US	1. Matching firms (size, size+BTM) / BHAR /ew. Vw	1. Traditional t- test 2. White corrected t-test (for CTAR)
			2. 5-factor model including market (size, growth , momentum, liquidity premiums) CTAR / vw	
			3. 7- factor model including macroeconomic factrs / CTAR / vw	
Ho (2005)	Rights Issue and Placings	UK	1. Matching firms (size+ industry, BTM+ industry, size+ BTM) / BHAR / ew, vw	1. Traditional t-statistic
			2.FF- 3 factor model/ CTAR / ew, ve	2. skewness-adjusted t- statistic Lyon et al., 1999)

			3. Carhart - 4factor model /CTAR/ew, vw	
Clarke et al. (2004)	SEO	US	1. 210 reference portfolios (size + MTB+ past performance)/ BHAR/ ew	1. Bootstrapped p-values for means (Lee, 1997) 2. Wilcoxon for medians
Schultz (2003)	IPO, SEO	US	1. Market -adjusted /CAR, CTAR / ew, vw 2. Simulated /CAR, BHAR, WR / ew, vw	1. T-tests
Roosenboom et al. (2003)	IPO	Netherlands	1. Market -adjusted (index) / CAR, BHAR, CTAR / ew, vw 2. Reference portfolios (size, book to market) / BHAR/ ew	1. Parametric t-test 2. Wilcoxon signed ranks
Gompers and Lerner (2003)	IPO	US	1.Market -adjusted (index) / CAR, BHAR, CTAR ew.vw 2. Reference portfolios (size+BTM) / BHAR, CAR, CTAR / ew, vw 3. CAPM /CTAR / ew, vw 4. FF-3factor / CTAR / ew, vw	1. Skewness - adjusted t-statistic (Lyon et al., 1999) 2. Traditional t-statistic (for CTAR)
Ritter and Welch (2002)	IPO	US	1. Market - adjusted (index) / BHAR / vw 2. Matching firms (size + BTM) / BHAR / ew 3. FF-3factor model / CTAR / ew	1. Traditional t-statistic
Eberhart and Siddique (2002)	SEO and Debt issue	US	1. Matching firms (size+ BTM) / BHAR / ew, vw 2. Reference portfolios (rating + duration for bonds) / BHAR 3. FF- 3factor model / CTAR / ew, vw 4. 6 factor bond model (Elton etal,. 1995) / CTAR / ew, vw	1. T-statistic (Lee, 1997 for stock) 2. Bootstrapped skewness - adjusted t-statistic (Lyon et al., 1999 for bonds 3. Returns and factors are standardized by the monthly (cross - sectional) standard deviatons (for CTAR)
Hertzel et al. (2002	Private placements	US	1. Matching firms (MV, industry + MV, BTM +MV) / BHAR / ew 2. FF- 3factor model / CTAR , BHAR /ew	1. Traditional t-statistic 2. Skewness adjusted t-statistic (Lyon et al., 1999)

			3. CAR: match by operating income and industry (following Loughran and Ritter , 1997) / ratio comparisons / ew	3.Non - parametric bootstrap procedure (Mitchell and Stafford , 2000)
Clarke et al. (2001)	Completed and Cancelled	US	1. Reference portfolios (size+ MTB) / BHAR / ew	1. Bootstrapped skweness adjusted t-statistic
DuCharme et al. (2001)	IPO	US	1. Market - adjusted / BHAR / ew, vw	1. Traditional t –test
			2. Eckbo et al. (2000) multifactor model / BHAR / ew, ve	2. Wilcoxon rank-sum
Jelic et al. (2001)	IPO	Malaysia	1. Market - adjusted / CAR, BHAR, WR / ew	1. Time series adjusted t –statistic
			2. Matching firms (size + industry) / CAR, BHAR, WR /ew	2. Skewness adjusted t- statistic
Brous et al. (2001)	SEO	US	1. Matching firms (size, size+BTM, size+industry, performance) / BHAR / ew	1. Traditional t-statistics 2. Wilcoxon sign rank
Eckbo and Masulis Norli (2000)	Seasoned debt issues	US	1. Matching firms (size+ BTM) / BHAR / ew	1. T-statistics on Students t- distribution
			2. 7-Factor model including macroeconomic factors / CTAR / ew	2. White corrected t – tests
Mitchell and Stafford (2000)	Mergers, SEO, Share repurchases IPO and SEO	US	1. Reference portfolios (size+ BTM) / BHAR, CTAR / ew , vw	1. Non- parametric bootstrap procedure
			2. FF-3factor model / CTAR / ew, vw	2. Time series on standardized CTAR t-statistic
Brav et al. (2000)	IPO and SEO	US	1. Market- adjusted (index)/ BHAR, CAR, WR / ew,vw	1. Traditional t-tests
			2. FF- 3factor model / CTAR /ew ,vw	
			2.Reference portfolios (5x5 size +BTM, 4x4x4 size + BTM + price momentum) / BHAR, CAAR, WR /ew, vw	
			3. Carhart (1997) 4 factor model / CTAR /vw	

Brav (2000)	IPO	US	1. Market - adjusted (index) / vw	1. Non- parametric bootstrap procedure (Bayesian approach)
			2. FF - 3factor model / CTAR / ew	
Loughran and Ritter (2000)	New issues + simulated data	US	1. Reference portfolios (size + BTM) / BHAR /ew , vw	1. t-statistic using White (1980) corrected coefficients
			2. FF- 3factor model / CTAR /ew, vw	
Jegadeesh (2000)	SEO	US	1. Market -adjusted (indexes) / BHAR, WR / ew, vw	1. Autocorrelation adjusted t-statistic
			2. Reference porfolios (size, size+ BTM, size+E/P, size decile+ Returns(lag6), size decile +Returns (lag 36)/ BHAR, WR/ ew, vw, calendar month weighted	2. Test statistic extending Hansen and Hodrick (1980) intuition that each sample observation is not necessarily equally weighted (p. 13)
			3. FF-3factor model / CTAR / ew	3. t-statistic for 3 and 4 factor models
			4. Carhart - 4factor model / CTAR / ew	4. F-statistic testing the hypothesis of jointly equal AR between size sub-samples
Espenlaub et al. (2000)	IPO	UK	1. CAPM / CAR, CTAR / ew	1. Crude adjusted t-test (Brown and Warner , 1980)
			2. Reference portfolio (size) / CAR / ew	
			3. Market - adjusted (for small stocks) / CAR / vw	
			4.FF- 3 factor model / CAR, CTAR / vw	
			5. RATS model (Agrawal et al., 1992) / CAR / vw	
Stehle et al. (2000)	IPO, SEO	Germany	1. Market -adjusted / BHAR, WR/ ew, vw	1. Traditional t-test
			2. Reference portfolios (size) / BHAR , WR / ew,vw	2. Bootstrapped skewness adjusted t-test
			3. Matching firms (size) / BHAR, WR / ew, vw	
Shivakumar (2000)	SEO	US	1. Market - adjusted / BHAR / vw	1. Traditional t-test

			2. Matching firms (size + BTM) / BHAR / ew	2. Fama -McBeth (in multivariate regressions using Market - adjusted AR)
			3. FF - 3facor /CTAR/ew	
Kang et al.	Debt and Equity issues (private , public , rights)	Japan	1. Matching firms (size, size+BTM)/BHAR /ew	1. Bootstrapped p-value 2. Median p-value 3. Traditional t-test (when annual BHARand CTAR)
			2. Reference portfolios (size+BTM) / CTAR /ew, vw	
Teoh et al. (1998a)	IPO	US	1. Market - adjusted (index) / CAR, BHAR / vw	1. Traditional t-statistic
			2. FF-3factor model / CTAR /ew, vw	2. Fama- McBeth statistics
Teoh et al. (1998b)	SEO	US	1. Market - adjusted /BHAR /ew	1. Time - series t – statistic
			2. FF- 3factor model BHAR / ew	2. White t - test and Fama - Mc Beth (in multivariate regressios using Market - adjusted AR)
Rangan (1998)	SEO	US	1. Market - adjusted (index) / BHAR / vw	1. Wilcoxon sign rank test
Cai (1998)	Right issues	Japan	1. Matching firms (size, size+MTB, book assets+ industry) / BHAR, WR / ew	1. Traditional t-statistic 2. Wilcoxon sign rank test
Cai and Loughran (1998)	SEO	Japan	1. Matching firms (size+ MTB, MTB)/ BHAR , WR	1. Skewness adjusted t-test (Lyon et al., 1999)
			2. TSE index, Industry reference portfolios / BHAR, WR / ew	2. Wilcoxon sign rank test
Chaney and Lewis (1998)	IPO	US	1. Market - adjusted (index)/CAR / vw	1. Kruskal - Wallis to test the differences among sub-groups
			2. 50 Reference portfolios (size+MTB) / CAR / ew	
Brav and Gompers (1997)	IPO, venture and non-venture companies	US	1. Market -adjusted (indexes) / BHAR, WR/ ew, vw	1. Traditional t-statistics
			2. Reference portfolios (size +BTM)/ BHAR, WR / ew, vw	

			3. FF industry portfolio / BHAR, WR/ ew, vw	
Loughran and Ritter (1997)	SEO	US	1. Market - adjusted (index) / CAR / vw, 1 year average annual geometric (compounded), average annua arithmetic	1. Wilcoxon non-parametric test 2. Traditional t-statistic
Lee (1997)	SEO	US	1. Matching firms (size + industry, past return +size+BTM)/BHAR, WR/ew	1. Traditional t-statistic 2. Bootstrapped p- value
Spiess and Affleck - Graves (1995)	SEO	US	1. Reference portfolio (size)/ BHAR/ ew	1. Traditional t-statistic
			2. Matching firms (size + industry, Size+ BTM) / BHAR /ew	
			3. Market -adjusted (index) BHAR / control firms are also matched with the indexes / ew	
Loughran and Ritter (1995)	IPO and SEO	US	1. Matching firms (size matched) / BHAR , WR/ ew, vw	1. Traditional t-statistic2. Time -series and cross sectional statistics based on Fama- Mac Beth approach
			2. Market - adjusted (index models) / BHAR, WR/ vw,vw	
			3. Cross sectional monthly characteristics model with a dummy variance for event vs non-event firms / ew	
Levis(1995)	IPO,SEO	UK	1. Market -adjusted (indexes) /CAR, BHAR, WR / vw	1. Time-series adjusted t-statistic
			2. Reference portfolios (size) / CAR, BHAR, WR / ew	
Levis (1993)	IPO	UK	1. Market -adjusted (indexes) /CAR, BHAR, WR / vw	1. Time - series adjusted t-statistic
Ritter (1991)	IPO	US	1. Market -adjusted (indexes) / CAR, BHAR, WR / vw	1. Traditional t – statistic
			2. Matching firms (size+industry) /CAR, BHAR, WR / ew	2. Time series adjusted –statistic
			3. Size adjusted index / CAR, BHAR, WR/ ew	

This table presents the choices of published studies investigating firm long run abnormal returns (AR) around Initial Public Offering (IPO)and SEO, small high growth firms that are more sensitive to the bad model problems. The table excludes studies examining only the long run operating performance of IPO and SEO firms as well as studies investigating long run AR driving factors without reporting clear statistical AR test.The first column of the table indicates the author names and uear of punlication. The second and third columns indicate the xorporate event and arket if investigation, respectively. The models of expected performance used, return computation methods (io, CAR, BHAR, CTAR) and portfolio weighting are presented in the fourth column The last column includes information about the tests of statistical inference used by each article. CTAR represents calendar time AR, CAR and BHAR is cumulative and buy and hold AR, respectively. FF-3factor and Carhart-4factor models stand for the Fama and French (1995) and Carhart (1997) factor models, respectively. Market model stands for the traditional market model, market adjusted stands for index model and CAPM for the known capital asset pricing model.When Matching firms and Reference portfolios are used as benchmark models, parentheses provide information about the relevant risk adjustments used. WR stands for wealth relatives, ew and vw denote portfolios/indexes with equal weightings and value weightings , respectively. BTM and MTB represent the book to market and market to book ratios, respectively. Choosing Among Alternative Long Run event study techniques , Dionysia Dionysiou, Journal of Economics Surveys 2015.

Table B

Techniques of control heteroskedasticity and autocorrelation

Serial Correlation	Lagrange multiplier test of residual serial correlation	In one of the cases the regression line we have that the variation of disrupting condition is stable and in another that the covariance of the disturbing conditions are zero. • If the assumptions are not met, then we have the phenomenon of autocorrelation or autoregression	Control autocorrelation First Class	Control autocorrelation of any class
			1. Diagram of the dispersion Control of Von Neumann 2. Control of Durbin-Watson 3. h-Durbin control 4. Alternative control Durbin 5. Control of t 6. Control Geary or flows control7. Control of independence X2 8. Control of Berenblut-Webb	1.Control Breusch-Godfrey 2.Control of Wald 3. Control of Box-Pierce 4. Control of Wallis (refer to fourth order autocorrelation)
Heteroscedasticity	Koenker(1981), Koenker–Basett(1982) Based on the regressions of squared residuals on squared fitted values	The problem of heteroskedasticity usually shown in cross-section data and the problem of autocorrelation in longitudinal data, however there are cases where the heteroscedasticity occurs in temporal .Researcher elements in their attempts to build predictive models for financial assets noticed that at various times the variables exhibit high variability	1. Specimen of Arch 2. Specimen of Garch 3. Specimen of Garch - M	
		If you try to keep such a predictive model will arrive in some periods of the forecast errors are large (unstable periods) and at other times small (quiet periods), ie the variations in of errors tended to cluster in time by size presenting a kind of heteroskedasticity in treaty		

Table C

Results of 2014 EU-Wide stress test

		Common Equity Tier 1 Capital	Total Risk Exposure	Ciet 1 ratio 2013	Ciet 1 ratio 2016 Bas.	Ciet 1 ratio 2016 Adv.	Memo item :Fully loaded CET1 ratio 2016 Bas.	Memo item :Fully loaded CET1 ratio 2016 Adv.
Austria								
	BAWAG P.S.K. Bank für Arbeit und Wirtschaft und Österreichische Postsparkasse AG	2414	16879	14,3%	11,9%	8,5%	7,50%	4,50%
	Raiffeisenlandesbank Niederösterreich-Wien AG	2203	13074	16,8%	17,2%	11,8%	17,20%	11,40%
	Raiffeisenlandesbank Oberösterreich AG	2743	26634	10,3%	11,3%	7,9%	11,50%	7,50%
	Erste Group Bank AG	10173	101730	10,0%	11,2%	7,6%	10,60%	6,80%
	Raiffeisen Zentralbank Österreich AG	8936	92103	9,7%	9,5%	7,8%	5,60%	3,90%
	Österreichische Volksbanken-AG with credit institutions affiliated according to Article 10 of the CRR	2834	27451	10,3%	7,2%	2,1%	5,20%	0,00%
		29303	277871	10,5%	10,6%	7,4%		

		Common Equity Tier 1 Capital	Total Risk Exposure	2013	2016 Bas.	2016 Adv.	2016 Bas.	2016 Adv.
Belgium								
	Dexia NV	8507	53839	15,8%	10,8%	5,0%	10,80%	5%
	Belfius Banque SA	7096	52532	13,5%	11,0%	7,3%	10,50%	6,50%
	KBC Group NV	11777	92873	12,7%	12,4%	8,3%	10,90%	6,30%
	AXA Bank Europe SA	770	5255	14,7%	12,7%	3,4%	12,70%	3,00%
	Investar (Holding of Argenta Bank- en Verzekeringsgroep	1381	5726	24,1%	20,1%	14,7%	20,10%	14,70%
		29531	210225	14,0%	11,9%	7,2%		

Cyprus		Common Equity Tier 1 Capital	Total Risk Exposure	2013	2016		2016	
					Bas.	Adv.	Bas.	Adv.
	Hellenic Bank Public Company Ltd	237	4531	5,2%	9,1%	-0,5%	9,00%	-1,30%
	Co-operative Central Bank Ltd	-322	8667	-3,7%	0,5%	-8,0%	0,50%	-8,00%
	Bank of Cyprus Public Company Ltd	1714	23530	7,3%	12,9%	1,5%	12,90%	1,50%
		1629	36728	4,4%	9,5%	-1,0%		

Denmark		Common Equity Tier 1 Capital	Total Risk Exposure	2013	2016		2016	
					Bas.	Adv.	Bas.	Adv.
	Danske Bank	16463	120384	13,7%	14,5%	11,7%	14,00%	11,10%
	Jyske Bank	2264	15235	14,9%	18,6%	13,6%	18,40%	13,30%
	Sydbank	1307	9544	13,7%	15,5%	12,9%	15,50%	12,90%
	Nykredit	7317	47260	15,5%	16,6%	10,9%	16,60%	10,90%
		27351	192423	14,2%	15,4%	11,7%		

Finland		Common Equity Tier 1 Capital	Total Risk Exposure	2013	2016		2016	
					Bas.	Adv.	Bas.	Adv.
	OP-Pohjola Group	6640	40564	16,4%	17,6%	12,0%	16,80%	11,20%
		6640	40564	16,4%	17,6%	12,0%		

France		Common Equity Tier 1 Capital	Total Risk Exposure	2013	2016		2016	
					Bas.	Adv.	Bas.	Adv.
	Banque PSA Finance	2679	19054	14,1%	14,2%	12,8%	13,90%	12,50%
	BPI France (Banque Publique d'Investissement)	13159	43263	30,4%	32,9%	30,7%	34,30%	31,70%
	C.R.H. - Caisse de Refinancement de l'Habitat	314	5474	5,7%	5,7%	5,5%	5,70%	5,50%
	Groupe Crédit Mutuel	32637	237207	13,8%	15,7%	12,9%	15,60%	12,80%
	La Banque Postale	5748	57239	10,0%	10,7%	9,2%	11,00%	9,40%

RCI Banque	2562	21890	11,7%	12,1%	9,1%	12,10%	9,10%
Société de Financement Local	1446	6204	23,3%	25,8%	13,2%	25,50%	13,00%
BNP Paribas	65508	622205	10,5%	10,5%	8,1%	10,40%	7,60%
Groupe Crédit Agricole	58831	544976	10,8%	11,9%	8,8%	11,80%	8,60%
Groupe BPCE	41199	410521	10,0%	10,1%	7,0%	9,90%	6,40%
Société Générale	36633	343115	10,7%	10,6%	8,1%	9,70%	7,10%
	260716	2311148	11,3%	11,8%	9,0%		

Germany		Common Equity Tier 1 Capital	Total Risk Exposure	2013	2016		2016	
					Bas.	Adv.	Bas.	Adv.
	Aareal Bank AG	2187	13344	16,4%	16,5%	11,8%	16,20%	11,40%
	Deutsche Apotheker- und Ärztebank e	1738	10593	16,4%	18,4%	14,7%	18,40%	14,60%
	HASPA Finanzholding	3930	31550	12,5%	12,5%	10,7%	12,50%	10,70%
	IKB Deutsche Industriebank AG	1295	14316	9,0%	8,8%	6,5%	8,10%	6,10%
	KfW IPEX-Bank GmbH	2398	18769	12,8%	12,3%	9,4%	11,90%	9,00%
	Landeskreditbank Baden-Württemberg-Förderbank	2933	21740	13,5%	14,5%	11,2%	14,50%	11,20%
	Landwirtschaftliche Rentenban	2906	17179	16,9%	17,7%	12,9%	17,70%	12,90%
	Münchener Hypothekenbank Eg	532	7730	6,9%	5,8%	2,9%	5,70%	2,90%
	NRW.Bank	17973	48098	37,4%	33,8%	31,5%	33,40%	31,10%
	Volkswagen Financial Services AG	7772	82616	9,4%	10,4%	7,0%	10,30%	6,50%
	Wüstenrot Bausparkasse AG	778	7346	10,6%	9,7%	6,9%	9,70%	6,90%
	Wüstenrot Bank AG Pfandbriefbank	393	4576	8,6%	8,0%	6,5%	8,00%	6,50%
	Deutsche Bank AG	47312	353103	13,4%	12,6%	8,9%	10,50%	7,00%
	Commerzbank AG	23523	217059	10,8%	11,7%	8,0%	10,60%	6,90%
	Landesbank Baden-Württemberg	11923	88542	13,5%	12,3%	7,4%	11,10%	5,50%
	DZ Bank AG Deutsche Zentral-Genossenschaftsbank	8963	99715	9,0%	8,7%	6,0%	7,80%	4,90%
	Bayerische Landesbank	12360	93669	13,2%	12,4%	9,4%	9,70%	7,00%
	Norddeutsche Landesbank-Girozentrale	7236	71426	10,1%	12,9%	9,2%	12,30%	8,50%
	Hypo Real Estate Holding AG	4049	24484	16,5%	21,2%	10,8%	21,20%	10,80%

	HSH Nordbank AG	3781	37806	10,0%	9,4%	6,1%	8,30%	4,80%
	Landesbank Hessen-Thüringen Girozentrale	6932	56689	12,2%	11,6%	8,2%	10,90%	7,70%
	Landesbank Berlin Holding AG	3089	31217	9,9%	10,5%	6,8%	10,10%	6,50%
	DekaBank Deutsche Girozentrale	3613	25743	14,0%	12,3%	8,0%	11,80%	7,50%
	WGZ Bank AG Westdeutsche GenossenschaftsZentralbank	2225	22228	10,0%	9,7%	7,3%	6,90%	4,60%
		179841	1399538	12,8%	12,8%	9,1%		

Greece		Common Equity Tier 1 Capital	Total Risk Exposure	2013	2016		2016	
					Bas.	Adv.	Bas.	Adv.
	Eurobank Ergasias, S.A	2979	38114	7,8%	2,0%	-6,4%	-9,30%	-18,00%
	National Bank of Greece, S.A	4262	56686	7,5%	5,7%	-0,4%	-0,30%	-7,30%
	Alpha Bank, S.A.	7269	51754	14,0%	13,8%	8,1%	9,00%	1,30%
	Piraeus Bank, S.A.	5959	59715	10,0%	9,0%	4,4%	4,30%	-1,50%
		20469	206269	9,9%	8,0%	2,0%		

Hungary		Common Equity Tier 1 Capital	Total Risk Exposure	2013	2016		2016	
					Bas.	Adv.	Bas.	Adv.
	OTP Bank Ltd	3894	24478	15,9%	17,0%	11,9%	17,10%	12,00%
		3894	24478	15,9%	17,0%	11,9%		

Ireland		Common Equity Tier 1 Capital	Total Risk Exposure	2013	2016		2016	
					Bas.	Adv.	Bas.	Adv.
	Allied Irish Banks plc	8923	60958	14,6%	12,4%	6,9%	1,70%	-3,60%
	The Governor and Company of the Bank of Ireland	6549	55390	11,8%	13,2%	9,3%	7,90%	2,90%
	Permanent tsb plc	2155	16792	12,8%	8,8%	1,0%	6,30%	-2,80%
		17627	133140	13,2%	12,2%	7,0%		

Italy		Common Equity Tier 1 Capital	Total Risk Exposure	2013	2016 Bas.	2016 Adv.	2016 Bas.	2016 Adv.
	Banca Carige S.P.A. - Cassa di Risparmio di Genova e Imperia	898	22989	3,9%	2,3%	-2,4%	1,40%	-4,70%
	Banca Piccolo Credito Valtellinese, Società Cooperativa	1368	18203	7,5%	7,1%	3,5%	7,10%	3,30%
	Banca Popolare Dell'Emilia Romagna - Società Cooperativa	3644	43507	8,4%	8,3%	5,2%	8,10%	5,00%
	Banca Popolare Di Milano - Società Cooperativa A Responsabilità Limitata	2998	43528	6,9%	6,9%	4,0%	6,90%	3,90%
	Banca Popolare di Sondrio, Società Cooperativa per Azioni	1740	23603	7,4%	7,4%	4,2%	7,30%	4,00%
	Banca Popolare di Vicenza - Società Cooperativa per Azioni	2178	28712	7,6%	7,7%	3,2%	7,70%	2,80%
	Credito Emiliano S.p.A	1756	16158	10,9%	11,0%	8,9%	10,50%	8,40%
	Iccrea Holding S.p.A	1437	13480	10,7%	11,2%	7,4%	11,20%	7,30%
	Mediobanca - Banca di Credito Finanziario S.p.A	4272	50841	8,4%	9,2%	6,2%	9,30%	6,20%
	Veneto Banca S.C.P.A.	1444	25338	5,7%	5,9%	2,7%	5,80%	2,40%
	Intesa Sanpaolo S.p.A.	33333	284781	11,7%	11,2%	8,3%	10,80%	7,80%
	UniCredit S.p.A.	39164	408904	9,6%	9,6%	6,8%	9,30%	6,50%
	Banca Monte dei Paschi di Siena S.p.A.	5687	81393	7,0%	6,4%	-0,1%	5,30%	-3,50%
	Banco Popolare - Società Cooperativa	4234	53329	7,9%	6,7%	4,7%	5,60%	3,60%
	Unione Di Banche Italiane Società Cooperativa Per Azioni	7526	63669	11,8%	10,9%	8,2%	10,60%	7,90%
		111679	1178435	9,5%	9,3%	6,1%		

Latvia				2013	2016 Bas.	2016 Adv.	2016 Bas.	2016 Adv.
	ABLV Bank, AS	156	1600	9,8%	10,5%	7,7%	10,50%	7,70%
		156	1600	9,8%	10,5%	7,7%		

				2013	2016		2016	

Luxembourg					Bas.	Adv.	Bas.	Adv.
	Banque et Caisse d'Epargne de l'Etat, Luxembourg	2366	13891	17,0%	16,8%	12,8%	22,80%	17,60%
	Precision Capital S.A. (Holding of Banque Internationale à Luxembourg and KBL European Private Bankers S.A.)	1214	8662	14,0%	12,5%	8,3%	13,30%	8,10%
		3580	22553	15,9%	15,1%	11,2%		

Malta				2013	2016		2016	
					Bas.	Adv.	Bas.	Adv.
	Bank of Valletta plc	392	3661	10,7%	13,2%	8,9%	12,80%	8,60%
		392	3661	10,7%	13,2%	8,9%		

Netherlands				2013	2016		2016	
					Bas.	Adv.	Bas.	Adv.
	Bank Nederlandse Gemeenten N.V.	2582	11819	21,8%	22,3%	17,3%	22,70%	17,40%
	Nederlandse Waterschapsbank N.V.	1230	1696	72,5%	73,2%	54,0%	73,00%	53,80%
	ING Bank N.V.	30137	298786	10,1%	11,4%	8,7%	11,10%	8,20%
	Coöperatieve Centrale Raiffeisen-Boerenleenbank B.A	25262	210040	12,0%	11,2%	8,4%	10,40%	7,10%
	ABN AMRO Bank N.V	13991	115556	12,1%	13,6%	9,1%	13,50%	8,80%
	SNS Bank N.V.	2224	14905	14,9%	16,0%	6,8%	15,00%	4,90%
		75426	652802	11,6%	12,2%	8,9%		

Norway				2013	2016		2016	
					Bas.	Adv.	Bas.	Adv.
	DNB Bank Group	13683	120874	11,3%	14,4%	11,3%	14,40%	11,30%
		13683	120874	11,3%	14,4%	11,3%		

Poland				2013	2016		2016	
					Bas.	Adv.	Bas.	Adv.
	ALIOR BANK SA	593	4566	13,0%	15,0%	8,1%	15,00%	8,10%

BANK BPH SA	939	6689	14,0%	14,4%	10,8%	14,40%	10,80%
BANK HANDLOWY W WARSZAWIE SA	1182	6972	16,9%	16,2%	15,4%	16,20%	15,40%
BANK OCHRONY SRODOWISKA SA	307	2833	10,8%	10,5%	8,0%	10,70%	8,00%
GETIN NOBLE BANK SA	1026	11922	8,6%	10,2%	7,4%	10,20%	7,40%
POWSZECHNA KASA OSZCZEDNOSCI BANK POLSKI S.A. (PKO BANK POLSKI)	5343	37664	14,2%	17,5%	14,3%	17,50%	14,30%
	9390	70646	13,3%	15,4%	12,3%		

Portugal			2013	2016		2016	
				Bas.	Adv.	Bas.	Adv.
Caixa Geral de Depósitos, SA	6651	63870	10,4%	9,4%	6,1%	8,40%	4,90%
Banco Comercial Português, SA	4667	45502	10,3%	8,8%	3,0%	6,80%	-0,30%
Banco BPI, SA	3291	21710	15,2%	14,9%	11,6%	13,40%	9,50%
	14609	131082	11,1%	10,1%	5,9%		

Slovenia			2013	2016		2016	
				Bas.	Adv.	Bas.	Adv.
SID - Slovenska izvozna in razvojna banka, d.d.	336	1472	22,8%	25,3%	14,5%	25,30%	14,50%
Nova Ljubljanska banka d. d	1061	7283	14,6%	12,8%	5,0%	12,80%	4,80%
Nova Kreditna Banka Maribor d.d.	435	2777	15,7%	12,8%	4,4%	12,40%	3,90%
	1832	11532	15,9%	14,4%	6,1%		

Spain			2013	2016		2016	
				Bas.	Adv.	Bas.	Adv.
Banco Financiero y de Ahorros, S.A.	11175	105414	10,6%	14,3%	10,3%	12,00%	8,60%
Cajas Rurales Unidas, Sociedad Cooperativa de Crédito	2198	22098	9,9%	10,2%	8,0%	10,10%	7,60%
Catalunya Banc, S.A.	2599	21283	12,2%	12,5%	8,0%	12,50%	8,00%
Caja de Ahorros y M.P. de Zaragoza, Aragón y Rioja	2655	26475	10,0%	10,6%	7,9%	9,60%	6,70%
Kutxabank, S.A.	4375	36027	12,1%	13,1%	11,9%	12,10%	10,70%
Liberbank, S.A.	1419	18143	7,8%	9,4%	5,6%	7,00%	2,90%

NCG Banco, S.A.	2643	25958	10,2%	13,9%	9,1%	14,00%	9,00%
MPCA Ronda, Cádiz, Almería, Málaga, Antequera y Jaén	3627	33351	10,9%	11,9%	8,9%	10,80%	7,30%
Banco Santander, S.A.	56086	540248	10,4%	12,0%	8,9%	10,60%	7,30%
Banco Bilbao Vizcaya Argentaria, S.A.	36383	345041	10,5%	10,6%	9,0%	10,00%	8,20%
Caja de Ahorros y Pensiones de Barcelona	17544	170679	10,3%	11,6%	9,3%	9,60%	7,50%
Banco Popular Español, S.A	8481	84293	10,1%	10,9%	7,6%	9,80%	6,40%
Banco de Sabadell, S.A.	8227	80189	10,3%	10,2%	8,3%	9,80%	7,80%
Banco Mare Nostrum, S.A.	1930	21419	9,0%	11,5%	8,1%	11,10%	7,60%
Bankinter, S.A.	2781	23831	11,7%	12,9%	11,0%	12,40%	10,50%
	162123	1554449	10,4%	11,6%	9,0%		

Sweden			2013	2016		2016	
				Bas.	Adv.	Bas.	Adv.
Nordea Bank AB (publ)	22244	163722	13,6%	15,2%	12,0%	15,20%	12,00%
Skandinaviska Enskilda Banken AB (publ) (SEB	9986	68063	14,7%	15,0%	13,0%	15,00%	13,00%
Svenska Handelsbanken AB (publ)	10027	53746	18,7%	22,2%	16,9%	22,20%	16,90%
Swedbank AB (publ)	8890	48955	18,2%	19,3%	16,3%	19,30%	16,30%
	51147	334486	15,3%	16,9%	13,7%		

UK			2013	2016		2016	
				Bas.	Adv.	Bas.	Adv.
Royal Bank of Scotland Group plc	44104	514739	8,6%	9,7%	5,7%	9,70%	5,70%
HSBC Holdings plc	94725	880965	10,8%	12,0%	9,3%	12,00%	9,30%
Barclays plc	48248	530758	9,1%	9,8%	7,1%	9,80%	7,10%
Lloyds Banking Group plc	33659	328956	10,2%	13,6%	6,2%	13,60%	6,00%
	220736	2255418	9,8%	11,2%	7,6%		

Whether bank passed the stress test was determined according to the resulting Common Equity Tier 1 (CET1) ratio under the baseline and adverse scenario. The definition of Common Equity Tier 1 (CET1) of the CRR/CRD IV(ie the implementation of Basel III in the EU) was applied. In order to pass the stress test, banks needed to clear the CET(1) hurdle rates of 8% in the baseline scenario and 5,5% in the adverse scenario (European Banking Authority 2014 EU-Wide stress testing).

Table D

Control Equity of Reference Portfolio

		Abnormal Return of Stress test Announcements using CAPM methods	Beta Pre-Event Period	Beta Post-Event Period	Π(1+ri) Pre event Period	Π(1+ri) Post Event Period
Austria	Erste Group Bank AG	-0,004957	0,987478	0,976973	0,654863958	1,610700057
Belgium	KBC Group NV	0,005694	0,962952	0,983087	1,106659221	1,453261007
Denmark	Danske Bank	0,002761	0,983167	0,980021	1,279050042	1,198275862
	Jyske Bank	0,004268	1,004801	0,974103	1,095435685	1,031336088
	Sydbank	-0,003265	1,074791	0,965280	1,1325811	1,334993773
France	BNP Paribas	0,011083	0,964603	0,966734	1,08044164	0,645255474
	Société Générale	0,006287	0,895784	0,996828	1,007655902	1,185661003
Germany	Deutsche Bank AG	0,001360	0,974849	1,012236	0,73910501	0,897439101
	Commerzbank AG	0,007887	0,862951	0,999186	1,305971057	0,880994506
Hungary	OTP Bank Ltd	-0,004494	0,994877	0,967005	0,931551049	1,462394854
Italy	Credito Emiliano S.p.A	0,004443	0,965688	0,993546	1,327272727	1,128424658
	Mediobanca - Banca di Credito Finanziario S.p.A	-0,000370	0,928518	1,000496	1,161290323	1,386507937
	UniCredit S.p.A.	0,007802	0,878461	0,983570	1,179942071	0,939149279
	Unione Di Banche Italiane Società Cooperativa Per Azioni	0,006455	0,912328	0,996996	1,534210526	1,059176672
Malta	Bank of Valletta plc	-0,000670	1,002046	0,969461	1,027027027	1,131578947
Netherlands	ING Bank N.V.	0,004332	0,937967	0,982170	1,246917929	1,165725047
	ABN AMRO Bank N.V	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Norway	DNB Bank Group	0,003785	1,033676	0,982757	1,099700897	0,969174977
Poland	ALIOR BANK SA	#VALUE!	#VALUE!	0,959055	0,794063482	0,886493861
	BANK BPH SA	0,015085	0,886775	0,968855	0,827758621	0,616538221
	BANK HANDLOWY W WARSZAWIE SA	0,012705	0,999980	0,976568	0,977118644	0,579531657

	POWSZECHNA KASA OSZCZEDNOSCI BANK POLSKI S.A. (PKO BANK POLSKI)	0,007791	0,921646	0,969065	0,938205128	0,746378792
Portugal	Banco BPI, SA	0,014815	0,857229	0,987200	1,361003861	0,833333333
Spain	Banco Santander, S.A.	0,008199	0,999624	0,983923	1,30745417	0,7279818
	Banco Bilbao Vizcaya Argentaria, S.A.	0,006137	0,992041	0,990787	1,194077717	0,830095509
	Banco Popular Español, S.A	0,000699	1,043577	0,987840	1,143042979	0,709860978
	Banco de Sabadell, S.A.	0,002704	0,976875	0,982475	1,134486539	0,870933104
	Bankinter, S.A.	0,004561	1,010859	0,993450	1,640726329	1,062450593
Sweden	Nordea Bank AB (publ)	0,001561	1,036117	0,973720	1,052944676	1,03559322
	Skandinaviska Enskilda Banken AB (publ) (SEB	0,005167	1,003081	0,960536	1,203843514	0,992018244
	Svenska Handelsbanken AB (publ)	0,001722	1,039237	0,978725	1,055319569	1,038097913
	Swedbank AB (publ)	0,003015	1,029068	0,972812	1,096034696	1,048615037
UK	Royal Bank of Scotland Group plc	0,009878	0,904473	0,983193	1,005539359	0,852420992
	HSBC Holdings plc	0,002693	1,048892	0,968161	0,87970667	0,84834883
	Barclays plc	0,004607	0,913346	0,983816	0,800886951	1,021116847
	Lloyds Banking Group plc	0,010047	0,955365	0,971003	0,976832461	0,95189602
	Average	0,005275	0,956121	0,984835	1,113356117	0,99079339

Table E

Equities with restriction capital

		Abnormal Return of Stress test Announcements using CAPM methods	Beta Pre-Event Period	Beta Post-Event Period	Π(1+ri) Pre Event Period	Π(1+ri) Post Event Period	BHAR Pre event Period	BHAR Post Event Period	Disturbance of acvievment	BHAR* Pre event Period	BHAR* Post Event Period	PBHARi Pre event Period	PBHARi Post Event Period	WR Pre Event Period	WR Post Event Period
Cyprus	Hellenic Bank Public Company Ltd	0,01040	0,99246	0,96959	1,11258	0,36905	-0,0008	0,62175	0,6209724	-0,0236	0,619263	0,979188	0,37341	0,9993	0,37248
	Bank of Cyprus Public Company Ltd	0,00215	0,96057	0,94570	1	0,66667	-0,1134	0,32413	0,2107706	-0,1362	0,321644	0,880103	0,67455	0,8982	0,67286
Greece	Eurobank Ergasias, S.A	0,05235	0,49972	0,93006	0,38799	0,04075	-0,7254	0,95004	0,2246767	-0,7482	0,947556	0,341475	0,04124	0,3485	0,04113
	National Bank of Greece, S.A	0,05904	0,63784	1,03928	0,64762	0,0098	-0,4657	0,98099	0,5152524	-0,4886	0,978507	0,569972	0,00992	0,5817	0,0099
	Alpha Bank, S.A.	0,04620	0,71494	0,95936	1,07547	0,08947	-0,0379	0,90132	0,8634353	-0,0608	0,898837	0,946526	0,09053	0,966	0,09031
	Piraeus Bank, S.A.	0,08196	0,54743	0,92366	0,97248	0,00283	-0,1409	0,98796	0,8470841	-0,1638	0,985481	0,85588	0,00286	0,8735	0,00286
Ireland	The Governor and Company of the Bank of Ireland	0,00771	0,98513	0,99294	1,41379	1,14983	0,30044	0,15903	0,1414046	0,27756	0,161515	1,244284	1,16343	1,2698	1,16051
	Permanent tsb plc	0,01386	1,18534	1,02268	2,08013	0,65874	0,96677	0,33205	1,2988257	0,9439	0,329568	1,83073	0,66653	1,8683	0,66486
Italy	Banca Carige S.P.A. - Cassa di Risparmio di Genova e Imperia	0,00228	0,96533	0,97548	0,46969	0,42772	-0,6437	0,56307	-0,080593	-0,6665	0,560587	0,413379	0,43278	0,4219	0,4317
	Banca Piccolo Credito Valtellinese, Società Cooperativa	-0,00679	0,98355	1,02372	1,15032	1,33761	0,03697	0,34682	-0,30985	0,01409	0,349301	1,012405	1,35343	1,0332	1,35004
	Banca Popolare Dell'Emilia Romagna - Società Cooperativa	-0,00022	0,94044	1,01242	1,13838	1,19847	0,02503	0,20768	-0,182653	0,00215	0,210162	1,001894	1,21265	1,0225	1,20961
	Banca Popolare Di Milano - Società Cooperativa A Responsabilità Limitata	-0,00015	0,94522	0,99677	1,53048	1,59826	0,41712	0,60747	-0,190347	0,39425	0,60995	1,346977	1,61716	1,3747	1,61311
	Banca Popolare di Sondrio, Società Cooperativa per Azioni	-0,00410	0,89868	1,00153	0,9072	1,29234	-0,2062	0,30154	-0,507694	-0,229	0,304025	0,798434	1,30762	0,8148	1,30434

	Banca Monte dei Paschi di Siena S.p.A.	0,01180	1,01352	0,99525	0,57984	0,34922	-0,5335	0,64158	0,1080622	-0,5564	0,639095	0,51032	0,35335	0,5208	0,35246
Portugal	Banco Comercial Português, SA	0,01778	0,80610	0,98772	1,28824	0,63875	0,17489	0,35204	0,526932	0,15201	0,349561	1,133788	0,6463	1,1571	0,64469
Spain	Liberbank, S.A.	#VALUE!	#VALUE!	0,98955	1,7228	0,90334	0,60944	0,08746	0,6969005	0,58657	0,084976	1,516241	0,91402	1,5474	0,91173
	Average	0,01962	0,87175	0,98508	1,09231	0,6708	-0,021	0,31999	0,2989487	-0,0439	0,317508	0,96135	0,67874	0,9811	0,67704

Table F

Assessment Methodologies Estimating Abnormal Returns

Assesment Methodologies	Pre Event Period	Post Event Period	Difference
BHARi	-2,10%	-32,00%	-29,89%
WR	0,981100	0,677036	-0,304064
PBHARi	0,961349	0,6787372	-0,282612
CAPM			-0,014341
BHARi*	-4,39%	-31,75%	-27,36%

Table G

T –student test

Abnormal Return of Stress test Announcements using CAPM methods

Control Portofolio	Equities with Restriction Capital	PRE EVENT	POST EVENT
σ(CAPM Ab Return)	σ(Abnormal Ret)	σ(BHAR)	σ(BHAR)
0,005317977	0,02698	45,57%	52,45%
t statistic	t statistic	t statistic	t statistic
4,757452979	2,81574	-0,184709084	-2,440536733
pvalue (two sided)	pvalue (two side)	pvalue (two sided)	pvalue (two sided)
0,000094939943689541	0,01375	0,855931	0,027549

Table H

TABLE of CRITICAL VALUES for STUDENT'S *t* DISTRIBUTIONS

Column headings denote probabilities (α) ***above*** tabulated values.

d.f.	0.40	0.25	0.10	0.05	0.04	0.025	0.02	0.01	0.005	0.0025	0.001	0.0005
1	0.325	1.000	3.078	6.314	7.916	12.706	15.894	31.821	63.656	127.321	318.289	636.578
2	0.289	0.816	1.886	2.920	3.320	4.303	4.849	6.965	9.925	14.089	22.328	31.600
3	0.277	0.765	1.638	2.353	2.605	3.182	3.482	4.541	5.841	7.453	10.214	12.924
4	0.271	0.741	1.533	2.132	2.333	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	0.267	0.727	1.476	2.015	2.191	2.571	2.757	3.365	4.032	4.773	5.894	6.869
6	0.265	0.718	1.440	1.943	2.104	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	0.263	0.711	1.415	1.895	2.046	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	0.262	0.706	1.397	1.860	2.004	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	0.261	0.703	1.383	1.833	1.973	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	0.260	0.700	1.372	1.812	1.948	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	0.260	0.697	1.363	1.796	1.928	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	0.259	0.695	1.356	1.782	1.912	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	0.259	0.694	1.350	1.771	1.899	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	0.258	0.692	1.345	1.761	1.887	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	0.258	0.691	1.341	1.753	1.878	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	0.258	0.690	1.337	1.746	1.869	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	0.257	0.689	1.333	1.740	1.862	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	0.257	0.688	1.330	1.734	1.855	2.101	2.214	2.552	2.878	3.197	3.610	3.922
19	0.257	0.688	1.328	1.729	1.850	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	0.257	0.687	1.325	1.725	1.844	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	0.257	0.686	1.323	1.721	1.840	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	0.256	0.686	1.321	1.717	1.835	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	0.256	0.685	1.319	1.714	1.832	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	0.256	0.685	1.318	1.711	1.828	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	0.256	0.684	1.316	1.708	1.825	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	0.256	0.684	1.315	1.706	1.822	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	0.256	0.684	1.314	1.703	1.819	2.052	2.158	2.473	2.771	3.057	3.421	3.689
28	0.256	0.683	1.313	1.701	1.817	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	0.256	0.683	1.311	1.699	1.814	2.045	2.150	2.462	2.756	3.038	3.396	3.660
30	0.256	0.683	1.310	1.697	1.812	2.042	2.147	2.457	2.750	3.030	3.385	3.646
31	0.256	0.682	1.309	1.696	1.810	2.040	2.144	2.453	2.744	3.022	3.375	3.633
32	0.255	0.682	1.309	1.694	1.808	2.037	2.141	2.449	2.738	3.015	3.365	3.622
33	0.255	0.682	1.308	1.692	1.806	2.035	2.138	2.445	2.733	3.008	3.356	3.611
34	0.255	0.682	1.307	1.691	1.805	2.032	2.136	2.441	2.728	3.002	3.348	3.601
35	0.255	0.682	1.306	1.690	1.803	2.030	2.133	2.438	2.724	2.996	3.340	3.591
36	0.255	0.681	1.306	1.688	1.802	2.028	2.131	2.434	2.719	2.990	3.333	3.582
37	0.255	0.681	1.305	1.687	1.800	2.026	2.129	2.431	2.715	2.985	3.326	3.574
38	0.255	0.681	1.304	1.686	1.799	2.024	2.127	2.429	2.712	2.980	3.319	3.566
39	0.255	0.681	1.304	1.685	1.798	2.023	2.125	2.426	2.708	2.976	3.313	3.558
40	0.255	0.681	1.303	1.684	1.796	2.021	2.123	2.423	2.704	2.971	3.307	3.551
60	0.254	0.679	1.296	1.671	1.781	2.000	2.099	2.390	2.660	2.915	3.232	3.460
80	0.254	0.678	1.292	1.664	1.773	1.990	2.088	2.374	2.639	2.887	3.195	3.416
100	0.254	0.677	1.290	1.660	1.769	1.984	2.081	2.364	2.626	2.871	3.174	3.390
120	0.254	0.677	1.289	1.658	1.766	1.980	2.076	2.358	2.617	2.860	3.160	3.373
140	0.254	0.676	1.288	1.656	1.763	1.977	2.073	2.353	2.611	2.852	3.149	3.361
160	0.254	0.676	1.287	1.654	1.762	1.975	2.071	2.350	2.607	2.847	3.142	3.352
180	0.254	0.676	1.286	1.653	1.761	1.973	2.069	2.347	2.603	2.842	3.136	3.345
200	0.254	0.676	1.286	1.653	1.760	1.972	2.067	2.345	2.601	2.838	3.131	3.340
250	0.254	0.675	1.285	1.651	1.758	1.969	2.065	2.341	2.596	2.832	3.123	3.330
inf	0.253	0.674	1.282	1.645	1.751	1.960	2.054	2.326	2.576	2.807	3.090	3.290

https://en.wikipedia.org/wiki/Student%27s_t-distribution

Table I

Biases which prodeceed via autocorrelation and serial correlation

		PBHAR methods		BHAR methods	
		Pre Event Period	Post Event Period	Pre Event Period	Post Event Period
Cyprus	Hellenic Bank Public Company Ltd	0,020117641	-0,00093559	0,022874161	-0,002482448
	Bank of Cyprus Public Company Ltd	0,018081927	-0,0016901	0,022874161	-0,002482448
Greece	Eurobank Ergasias, S.A	0,007015682	-0,00010332	0,022874161	-0,002482448
	National Bank of Greece, S.A	0,0117102	-0,0000249	0,022874161	-0,002482448
	Alpha Bank, S.A.	0,019446601	-0,00022683	0,022874161	-0,002482448
	Piraeus Bank, S.A.	0,017584259	-0,000007	0,022874161	-0,002482448
Ireland	The Governor and Company of the Bank of Ireland	0,025564104	-0,00291498	0,022874161	-0,002482448
	Permanent tsb plc	0,037612778	-0,00167001	0,022874161	-0,002482448
Italy	Banca Carige S.P.A. - Cassa di Risparmio di Genova e Imperia	0,008492973	-0,00108434	0,022874161	-0,002482448
	Banca Piccolo Credito Valtellinese, Società Cooperativa	0,02080009	-0,00339105	0,022874161	-0,002482448
	Banca Popolare Dell'Emilia Romagna - Società Cooperativa	0,02058415	-0,00303831	0,022874161	-0,002482448
	Banca Popolare Di Milano - Società Cooperativa A Responsabilità Limitata	0,027673963	-0,00405183	0,022874161	-0,002482448
	Banca Popolare di Sondrio, Società Cooperativa per Azioni	0,016404013	-0,00327626	0,022874161	-0,002482448
	Banca Monte dei Paschi di Siena S.p.A.	0,010484649	-0,00088532	0,022874161	-0,002482448
Portugal	Banco Comercial Português, SA	0,023293948	-0,00161933	0,022874161	-0,002482448
Spain	Liberbank, S.A.	0,031151519	-0,00229009	0,022874161	-0,002482448
		0,019751156	-0,00170059	0,022874161	-0,002482448

Market Level Performance

Chart 1. Control Portfolio

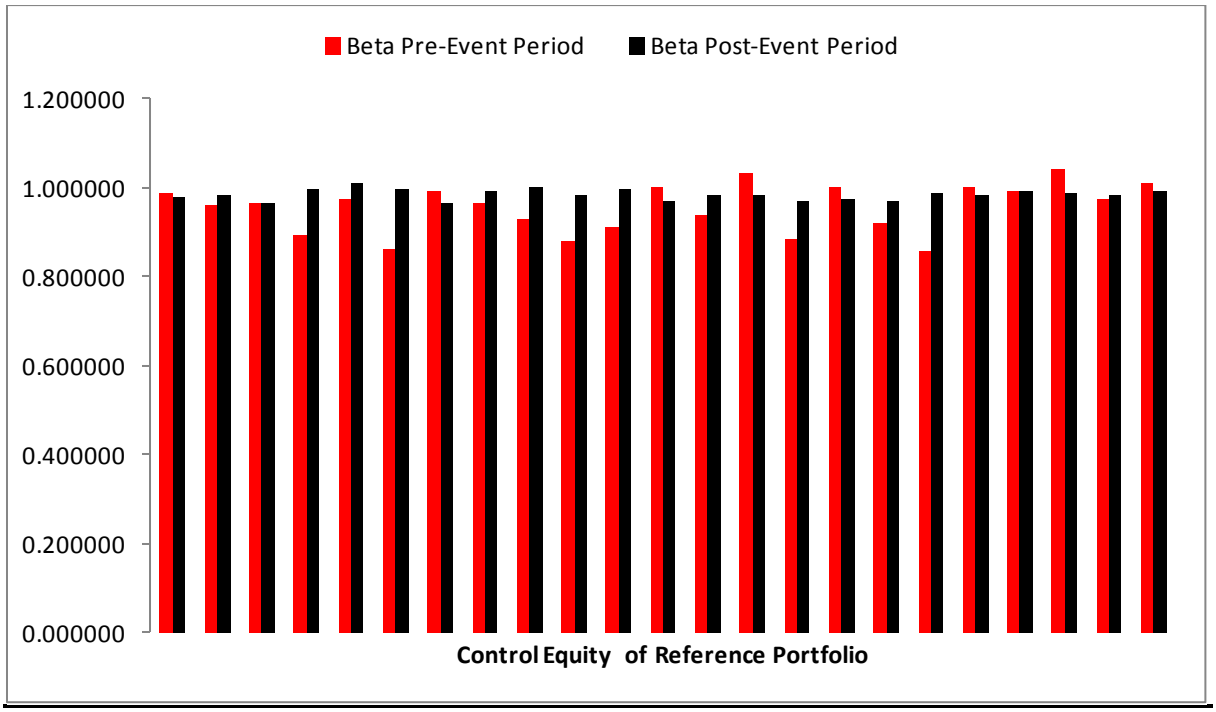


Chart 2. Restructuring Portfolio

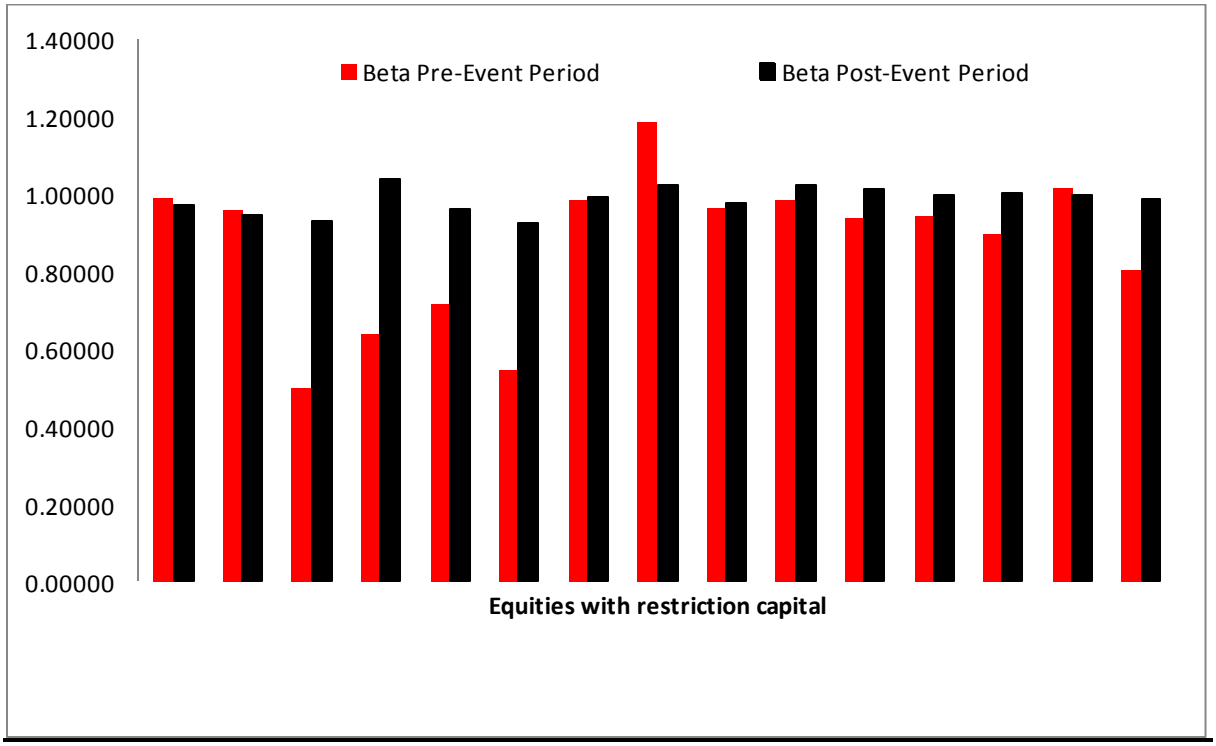
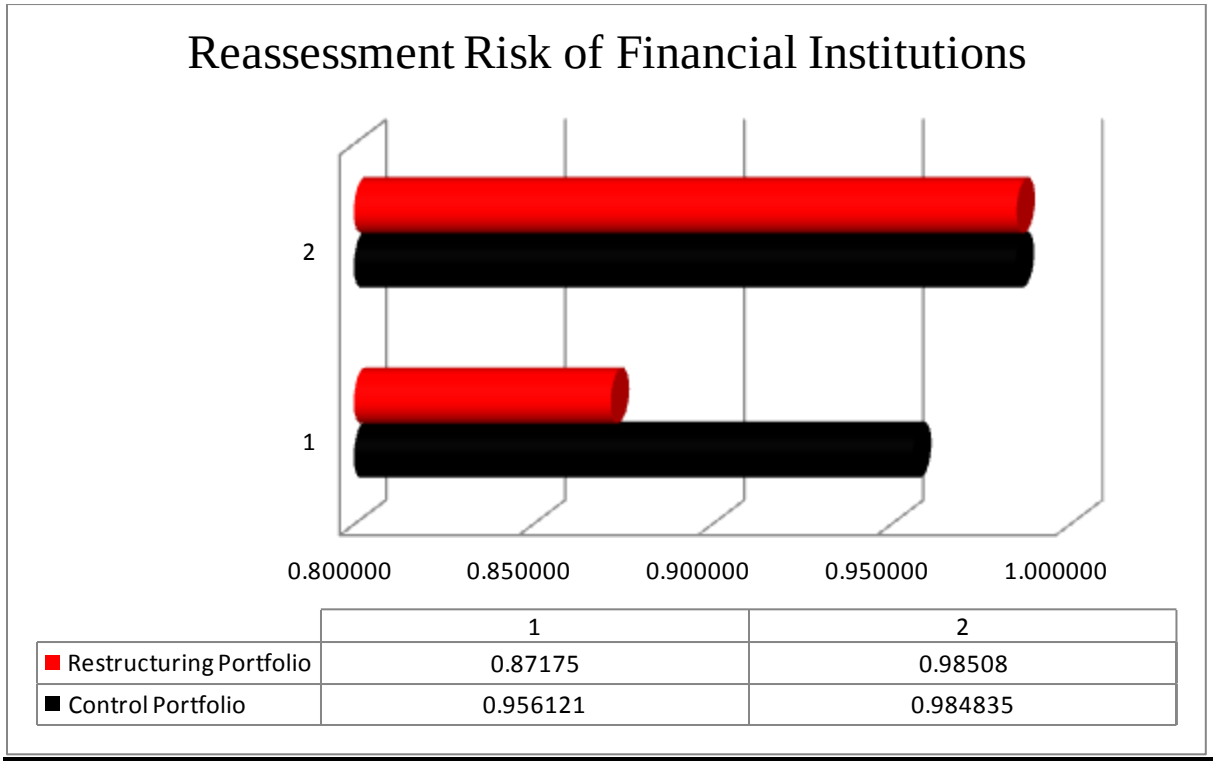
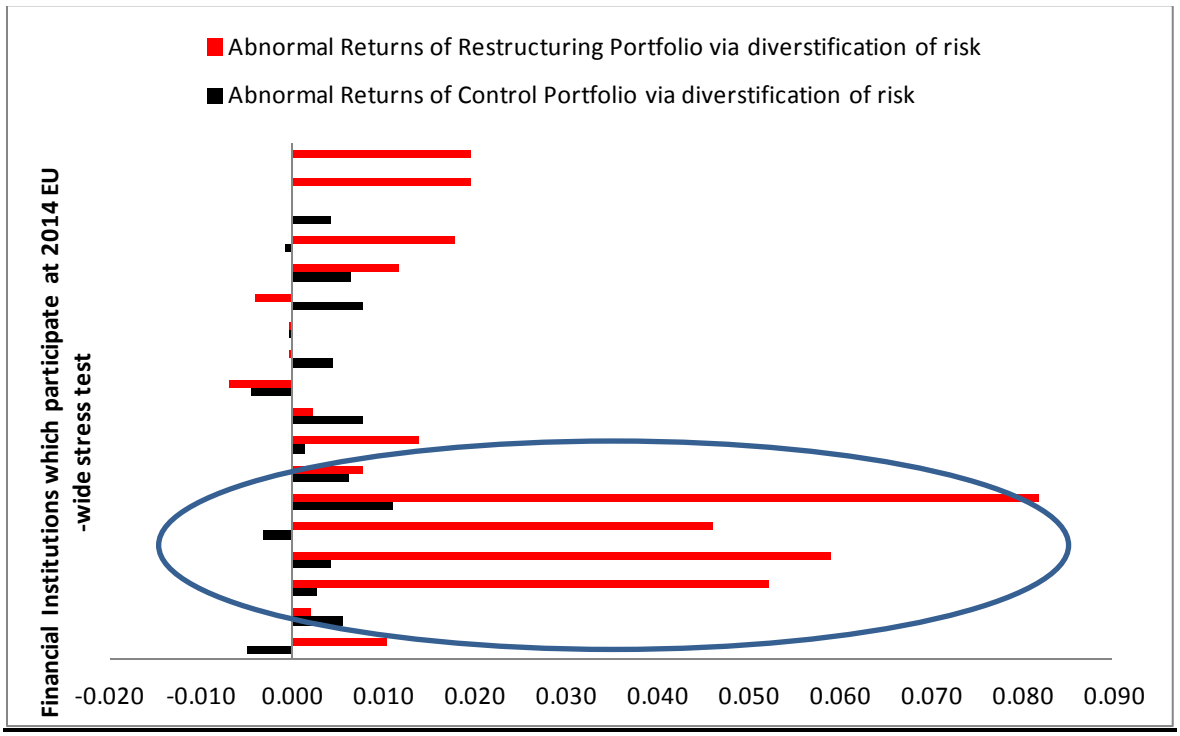


Chart 3. Beta Convergence



	1	2
Restructuring Portfolio	0.87175	0.98508
Control Portfolio	0.956121	0.984835

Chart 4. Abnormal Returns via diverstification of Risk



Sector Level Performance

Chart 1. Buy and Hold Abnormal Return

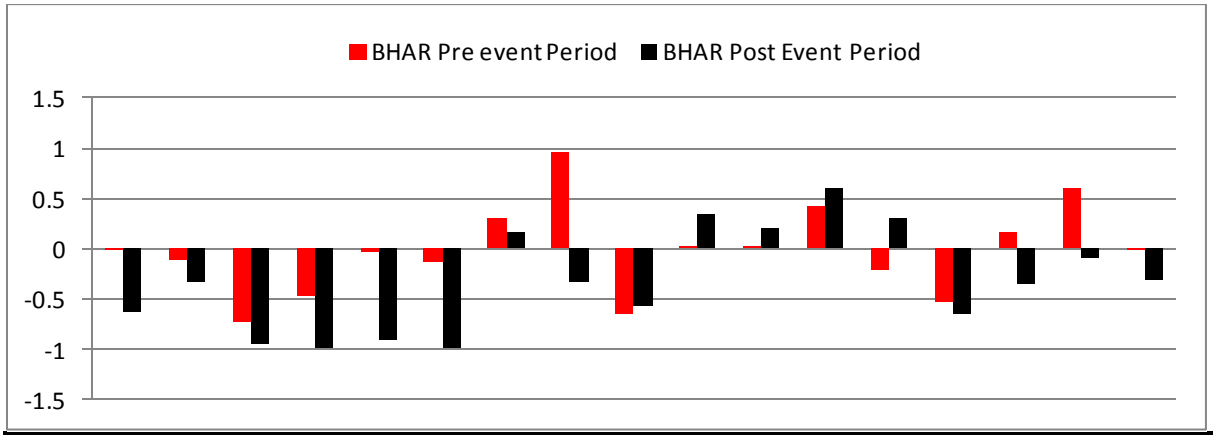
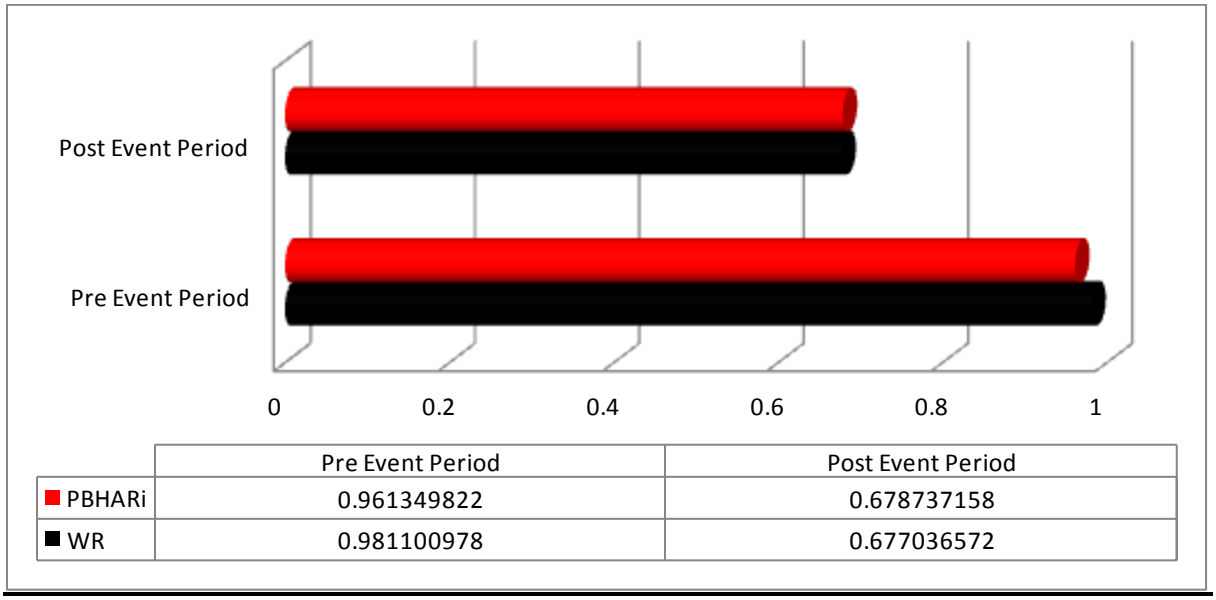


Chart 2. Persentance Buy and Hold vs Wealt Relative



	Pre Event Period	Post Event Period
PBHARi	0.961349822	0.678737158
WR	0.981100978	0.677036572

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