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EVIDENCE AGAINST THE MARKET EFFICIENCY THEORY: THE SMALL FIRM EFFECT IN DETAIL

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Academic year 2014/2015

Contents

Introduction

Is it possible to consistently beat financial markets? Do investors play particular trading strategies whenever investing in order to earn superior returns? Are such strategies reliable?
These are the questions I posed myself once I decided to investigate the degree of efficiency of financial markets. Since classical theories assumed both the perfect functioning of financial markets and the perfect rationality of investors, I had to evaluate them in the light of the empirical evidence a lot of economists such as Fama, French, Fisher and others collected over time. To solve my doubts I decided to structure the research in three distinct chapters, each one of which progressively contributes essential elements and data for the understanding of the analysis, in its entirety and complexity.

The first chapter basically introduces the Market Efficiency Theory; according to which financial markets fairly price securities and leave no room for arbitrage opportunities. In particular, Fama and French deeply investigated the issue and tested for three different and always increasing degrees of efficiency reflected by financial markets: the weak-form efficiency, the semi-strong-form efficiency and the strong-form efficiency. Since, in reality, financial markets are found to be perfectly efficient exclusively in their weak-form, alternative theories to the Market Efficiency one are presented and discussed, namely the Behavioral Finance and the Adaptive Market ones.

The second chapter, starting from the examination of the discrepancies between reality and the Market Efficiency Theory, enumerates, classifies and analyzes the five most recurring and effective market anomalies except for the Small Firm Effect. The fundamental intent is to verify whether such anomalies effectively characterize financial markets and if investors have the ability of profitably gaining from them. Each of the five selected anomalies is accurately investigated and supported by considerable empirical evidence.

Finally, the third chapter completely focuses on the Small Firm Effect, one of the most famous and documented empirical irregularity of financial markets. Each aspect of such phenomenon has been debated according to the maximum degree of accuracy as well as its causes.
Along with the empirical evidence provided by famous and renowned economists, I decided to personally conduct a survey aimed at demonstrating the effectiveness of the anomaly in recent years; results and methodologies are discussed in a specifically devoted paragraph.
On one hand, the dissertation tends to stress the huge distance between the Market Efficiency Theory and reality, while on the other hand, since conceivable justifications and progressive theories are also furnished, it tends to attenuate it.

Chapter 1:

The Market Efficiency Theory , contextualization and developments

1.1 Origins : Fama & French's intuitions

The main intuition behind the market efficiency hypothesis is that it is impossible to consistently beat the market due to the fact that its efficiency, causes outstanding shares prices to suddenly incorporate and reflect all relevant information. The theory asserts that in capital markets, neither stocks are traded at a value different from what is considered to be their fair value, nor investor have any possibility to gain from buying undervalued stocks or from short-selling overvalued ones. As a consequence, no financial actor should be able to outperform the overall market through accurate stock selection or market timing, and the only way he can possibly obtain higher returns is by purchasing riskier investments. In order to be defined efficient, a market must match the following requisites:

- A large numbers of investors, analyzing and valuing stocks for profit objectives.
- Independent and random information.
- Prices quickly adjusting to new information.
- Securities' prices reflecting all the available information.

The first time the term "Market Efficiency" appeared in a specialized publication was in a 1965 article by Eugene Fama , an American economist born from an Italian family who at first studied and then taught at the Booth School of Business of the University of Chicago.
In 1965 , his PhD dissertation thesis was published in the "Journal of Business" (an academic journal published by the University of Chicago) with the title "The Behavior of Stock Market prices".
In that article Fama discussed about fluctuations of stock prices and their fortuitous nature, concluding that according to empirical evidence, capital markets reflected a relevant degree of efficiency.
The American economist, in his thesis, asserted that current stock prices fully reflected all available information about the fundamental value of their firms and that an investor had no chance to earn superior returns, intended as returns exceeding overall market returns.
Fama had the absolute certainty that : "O*n average, competition , will cause the full effects of new*

information on intrinsic values, to be reflected "instantaneously" in actual prices ."(Fama 1965, p.56)-

The scientific foundation, on which the entire thesis is founded, was developed at three levels:

- Evidence deduced by weak-form tests, in which the information subset of interest was composed by past prices only .

- Evidence deduced by semi strong-form tests, in which the author was mainly concerned about the rapidity according to which prices adjusted to publicly available information.

- Evidence deduced by strong-form tests , in which the focal point was whether any economic agent (individual or groups) had monopolistic access to all information relevant to the formation of prices recently appeared in the market.

It's essential to note that each of these three sorts of tests attempted to ascertain three different degrees of market efficiency, respectively: weak-form efficiency, semi-strong-form efficiency and strong-form efficiency.

Before deeply discerning the methodologies according to which those tests were performed, it seems appropriate to precisely define each of the three forms of market efficiency, in details, with their implications.

The *weak-form efficiency* implies that current trading prices must fully reflect information contained in past history of prices, only. Nobody should be able to consistently beat the market observing and analyzing past prices histories and paths. The basic principle is that no market agent should be able to profits from information that are commonly acknowledged.

If individual investors or groups act rationally and everybody has the same knowledge, nobody has the possibility to gain advantage from some facts that everybody knows and thanks to which everybody has the same capacity to obtain profit.

The empirical analysis ,that will be produced all over this thesis ,will show how this form of market efficiency may be considered consistent and robust. Once transaction costs and trading expenses are included in the analysis, it results pretty difficult for any investor to systematically earn superior returns in the market.

The *semi-strong-form efficiency*, goes one step further, asserting that current trading prices must fully reflect not only information embedded in past history of prices, but also all publicly available information.

Public information ,more than past prices , includes not only financial data reported in official

documents such as income statements or annual reports, but also macroeconomics events related to variables such as inflation or unemployment.

It is worthwhile to note that this degree of market efficiency implies the existence of market analysts, which are essential in order to extrapolate all the information embedded in official documentation and make it available and easily accessible to all market participants.

In such a way, all market participants become aware of their inability to predict trends or anticipate market fluctuations. A fundamental role is played by the concept of "common knowledge" : everybody knows that everybody knows that everybody knows and so on and so forth, up to infinite.

The turning point is that if everybody acts rationally, according to the same available information set, no one should be able to significantly beat both the market and the other participants. No room for superior profits is left.

The *strong-form efficiency***,** instead, represent the highest possible degree of perfection that a financial market could achieve.

Such degree of efficiency, in particular, implies that stock prices not only should incorporate information like past prices history or publicly available data, but also private information.

In other words, the strong-form efficiency requires that each company's insider couldn't gain advantage from internal and private information. Whatever insider, for instance, is not allowed to profit from buying his company's shares one hour before the announcement of that company's intention to complete a very profitable acquisition[1], because at least in theory, stock prices had already fluctuated to absorb the new information.

The rationale is that the market is assumed to be able to predict and elaborate private information and immediately adjust prices accordingly, eliminating every arbitrage[2] opportunity.

In this scenario, the practice of insider trading[3] would not be profitable in any possible way.

Not surprisingly, empirical evidence (that will be successively provided) has denied the subsistence of strong-form efficiency in real capital markets.

Fama (1970) discussed about the performance of empirical tests for each of the three efficiency levels , reviewing and investigating the previous literature.

In order to test these hypotheses, he needed to construct tests on some mathematical/statistical

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[1] A corporate action in which a company buys most, if not all, of the target company's ownership stakes in order to assume control of the target firm. Acquisitions are often made as part of a company's growth strategy whereby it is more beneficial to take over an existing firm's operations and niche compared to expanding on its own. Acquisitions are often paid in cash, the acquiring company's stock or a combination of both.

[2] In economics and finance, arbitrage is the practice of taking advantage of a price difference between two or more markets: striking a combination of matching deals that capitalize upon the *imbalance, the profit being the difference between the market prices.*

[3] The buying or selling of a security by someone who has access to material, nonpublic information about the security.

ground.

Starting from the weak-form tests of efficient capital markets; he combined the concept of market efficiency with the one of "*random walk behavior*" of stock prices. The basic idea was that if markets were efficient, the correlation coefficient[4] between daily stock's returns over time (serial correlation) must compulsorily be zero or very close to it.

Fama ,noted that the first who were able to provide an exhaustive and complete theory of "Market Efficiency", were Samuelson and Mandelbrot ,respectively in 1965 and 1966. Before that date most of the material about the Market Efficiency Hypothesis was only an enormous collection of empirical evidence and data. No rigorous studies had been performed until then.

The first attempt to test for the random walk hypothesis, was those performed by Bachelier (1900) ;nevertheless his contribution was ignored for about sixty years . In fact, no one tried to develop a similar research until the introduction of computers, which made data collection and regression analysis much simpler and precise.

Successively, Kendall and Bradford (1953), examined the weekly behavior of nineteen indexes of the British industrial share prices and once carefully analyzed all the obtained data, through the aid of a prevalent graphical approach, they concluded : *"The series looks like a wandering one, almost as if once a week, the Demon of Chance drew a random number from a symmetrical population of fixed dispersion and added it to the current price to determine the next week's price."*(M. G. Kendall and A. Bradford Hill,1953 ,p.3)

As previously mentioned, those studies purely exploited statistical and regression analysis tools; in fact, they lacked the economic rationale and the ease of being interpreted that would have allowed them to be widely understood and accepted.

Generally, whenever economists (before Samuelson and Mandelbrot' s contributions) tried to justify the random walk behavior of stock prices, their reasoning usually needed the assistance of the "fair game" concept.

In a fair game all participants are expected to break even in the long run, and all odds and payoffs occur according to the laws of probability and not by external intervention. It is also acknowledged as a zero-sum game (where one's gain is others' loss), since every player must only break even over a period.

Applied to the capital market context, however, each participant in the long run is expected not to get returns in excess of market returns.

Fair games, as previously mentioned, imply the inability to pursue certain types of trading strategies

[4] a measure of the strength and direction of the linear relationship between two variables that is defined as the (sample) covariance of the variables divided by the product of their (sample) standard deviations

and most of the tests aimed at demonstrating the validity of these models, applied to stock exchanges, were basically concerned on serial covariance[5] of returns.

1.1.1 Tests for the weak-form efficiency

If prices of stocks followed a random walk behavior, their serial covariance should be zero or should, at least, approach it.

Fama (1965) tried to show the rationale as follow. Assuming that "x_t" is a "fair game", its expected value must be zero and its serial covariance can be defined as :

$E(\tilde{x}_{t+\tau}\,\tilde{x}_t) = \int_{x_t} x_t E(\tilde{x}_{t+\tau}|x_t) f(x_t) dx_t$, , where "f " represents a density function.

Since x_t is a "fair game" , it follows by construction that $E(\tilde{x}_{t+\tau}|x_t) = 0$

and as a consequence, for each time lag , the serial covariance of lagged values of a game that is defined fair, is zero as well. Furthermore, by construction, observations of a fair game variable are linearly independent between each other.

To validate all those observations, Fama (1965) constructed the following table:

[5] a measure of how much two random variables change together. The sign of the covariance therefore shows the tendency in the linear relationship between the variables. The serial covariance, instead, is the covariance between a variable and the lagged value of the same variable

First order serial correlation coefficients for dfferent time intervals between Log of Prices from 1957 to1962

Table 1.1

First-order Serial Correlation Coefficients for One-, Four-, Nine-, and Sixteen-Day Changes in Log_e Price

Stock	Differencing Interval (Days) One	Four	Nine	Sixteen
Allied Chemical	.017	.029	−.091	−.118
Alcoa	.118*	.095	−.112	−.044
American Can	−.087*	−.124*	−.060	.031
A. T. & T.	−.039	−.010	−.009	−.003
American Tobacco	.111*	−.175*	.033	.007
Anaconda	.067*	−.068	−.125	.202
Bethlehem Steel	.013	−.122	−.148	.112
Chrysler	.012	.060	−.026	.040
Du Pont	.013	.069	−.043	−.055
Eastman Kodak	.025	−.006	−.053	−.023
General Electric	.011	.020	−.004	.000
General Foods	.061*	−.005	−.140	−.098
General Motors	−.004	−.128*	.009	−.028
Goodyear	−.123*	.001	−.037	.033
International Harvester	−.017	−.068	−.244*	.116
International Nickel	.096*	.038	.124	.041
International Paper	.046	.060	−.004	−.010
Johns Manville	.006	−.068	−.002	.002
Owens Illinois	−.021	−.006	.003	−.022
Procter & Gamble	.099*	−.006	.098	.076
Sears	.097*	−.070	−.113	.041
Standard Oil (Calif.)	.025	−.143*	−.046	.040
Standard Oil (N.J.)	.008	−.109	−.082	−.121
Swift & Co.	−.004	−.072	.118	−.197
Texaco	.094*	−.053	−.047	−.178
Union Carbide	.107*	.049	−.101	.124
United Aircraft	.014	−.190*	−.192*	−.040
U.S. Steel	.040	−.006	−.056	.236*
Westinghouse	−.027	−.097	−.137	.067
Woolworth	.028	−.033	−.112	.040

* Coefficient is twice its computed standard error.

Source: The Journal of Finance, Vol. 25, No. 2, (May, 1970)

Table 1.1, shows serial correlations between consecutive variations in the logarithm of price ,for every stock belonging to the Down Jones Industrial Average[6]. Data cover the period 1957 - 1962.

It's interesting to note that serial correlations of consecutive changes in the natural logarithm of prices were reported for different time intervals, namely : one, four , nine and sixteen days.

Data reported in the table, indeed, reflect the clear evidence that a linear dependence relation can't be identified between consecutive price changes or compared rates of returns .

Essentially, serial correlation coefficients can be considered to be zero in absolute value on a statistically significant ground, even though in reality, in relation to the particular sample analyzed by Fama, significant statistically evidence of linear dependence between consecutive price's changes was detected in certain circumstances.

[6] The most famous stock index, belonging to the New York Stock Exchange, created by Charles Dow, father of the technical approach and founder of the Wall Street Journal.

Investigating the data, it may be seen that 11 out of 30 serial correlations of daily returns are more or less twice their respective standard error[7]. Moreover 22 out of 30 are strictly positive serial correlations.

In addition, looking at data relative to coefficients, measured in time distances of respectively four and nine days, it can be noticed that most of those data ,represent negative serial correlation coefficients (21 out of 30 for the data collected with four days lag and 24 out of 30 for data collected with nine days lag instead).

Anyway, Fama himself noticed that it was important to evaluate results taking into account the peculiarity and complexity of the investigated sample.

The table he elaborated, was constructed on 1200-1700 observations per stock collected each day.

If, in similar surveys, correlation coefficients insignificantly different from zero were recorded; they weren't usually considered a ground to reject the hypothesis relative to the random walk behavior of stock price.

Furthermore Fama, computed standard errors (SE), utilizing the formula SE= [1/(N-1)]^(1/2) ; accordingly a daily correlation coefficient of 0.04 ,for instance, that is very close to zero, is twice or so its standard error.

Such numbers indicate that price variation of previous days can only explain 0.29% of variations in current prices or equivalently, previous variations in prices can simply justify variations in current prices 0.29% (0,0029/1) of the times.

From an economic perspective, any inference against the Market Efficiency Hypothesis founded on these data, makes no or little sense.

According to Fama (1970), it seems unlikely that market agents are such skilled bookkeepers, able to profit from infinitesimal margins for market predictability.

Nevertheless he noticed that in some circumstances stock prices didn’t behave according to completely independent pattern . Particularly he argued that large price changes registered in one day were usually followed by large daily changes as well.

Since the sign of the changes, appeared to be statistically unpredictable, the rationale behind the Market Efficiency Hypothesis was not damaged but this incidence somehow weakened the robustness of the random walk theory.

In interrogating himself about the reasons why this phenomenon consistently occurred, Fama (1970), embraced the hypothesis that markets participants do not have the full capability of interpreting new information in the correct manner.

Sometimes prices will overreact to new information and sometimes the contrary happens. As

[7] the standard deviation of the sampling distribution of a statistic.

suggested above, the variation in price's sign follows a random path, it is not predictable; the first large change in price seems to represent an unbiased adjustment to the last price effects caused by the information arrival. Fama, in light of such results, argued the validity of the Market Efficiency Hypothesis and more precisely, of its semi-strong form.

1.1.2. Tests for the semi-strong-form efficiency

Tests regarding the validity of the Market Efficiency Hypothesis in its semi-strong version, are basically concerned with whether current prices fully reflect all available public information and accordingly if price adjustments due to the arrival of new information occur in the correct and unbiased way the theory predicts.

In these regards, Fama, Jensen, Fisher and Roll (1969) were the first who deeply analyzed the issue, providing the economic and scientific community with proofs and evidences. They principally analyzed the behavior of stock prices following a stock split announcement.

A stock split is defined as the procedure in which the number of shares per shareholders of a public company is increased without any further claim on real assets. The equity[8]'s value remains constant. Therefore a split announcement, on its own, is not indicative of any modification in the firm fundamental parameters.

Most of the times however ,stock splits are announced when the firm is forecasted to increase its performance in the future and therefore to maintain the dividend per share level constant, even for a greater number of shares.

Fama and its colleagues observed the path covered by both stock prices and returns, before and after a stock split announcement, to derive the highest possible amount of relevant inferences.

In order to compare all their measurements and data with what efficiency paradigms would have predicted, they employed the Capital Asset Pricing Model[9] (CAPM) as the main tool for computing expected prices and returns.

According to this model, if a stock reflects an abnormal or unexpected rate of return, it is incorporated in the regression residual term, denominated "u_m".

For a specified stock split, assume month "0" is the exact month in which the split really occurs, while month "-1" is the month before and month "1" is the month after the stock split.

The mean residuals over all split stocks for month "m" can be written as :

[8] On a company's balance sheet, the amount of the funds contributed by the owners (the stockholders) plus the retained earnings (or losses). Also referred to as "shareholders' equity".

[9] A model used to determine a theoretically appropriate required rate of return of an asset, if that asset is to be added to an already well-diversified portfolio, given that asset's non-diversifiable risk.

$$u_m = \sum_{j=1}^{N} \frac{\hat{u}_{jm}}{N},$$

where "u_{jm}" stands for the sample regression residual for security j and N is simply the number of splits.

The sum of all average residuals denoted by "U_m" is, consequently, defined as :

$$U_m = \sum_{k=-29}^{m} u_k.$$

"U_m" can be intended as the cumulative deviations, from month -29 to month "m", of split shares returns with respect to returns predicted by the CAPM.

The experimental survey produced by these economists, involved a sample of 940 stocks that had been split, sampled from the NYSE from 1927 to 1959.

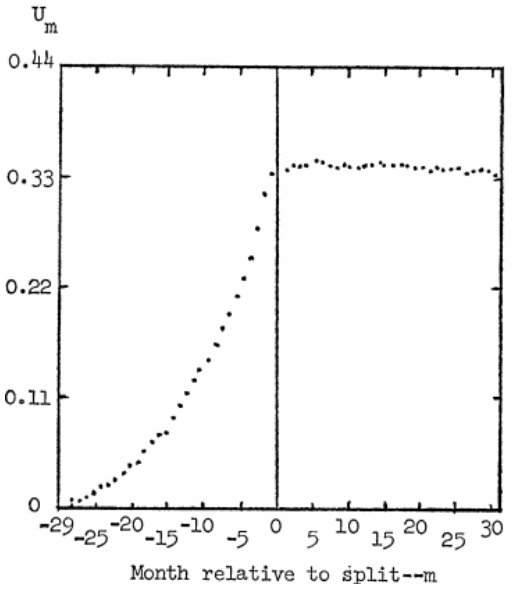
In order to furnish the most possible unbiased results, the authors decided to sample all the stocks that were listed at least twelve months before and after the stock split.

Results were summarized and valued through the assistance of a purely graphical approach .

The most significant graph is the following:

Cumulative residuals before and after a split-announcement

Figure 1.1



Source: The Journal of Finance, Vol. 25, No. 2, (May, 1970)

It's pretty shiny how cumulative residuals (independently of their sign) increase 29 months before the stock split.

Unfortunately such a sudden increase in residuals can't be related to the stock split announcement,

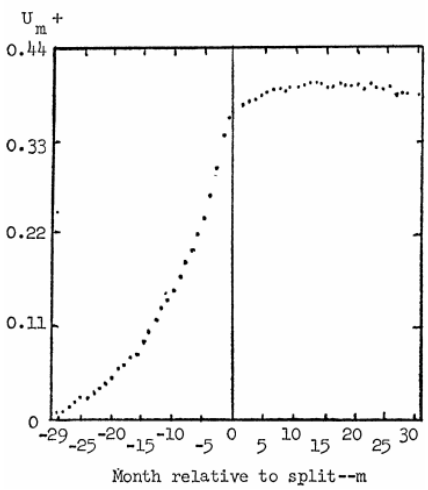
since usually the average time period between a split announcement and the effective split is no more than four months.

Fama, Jensen, Fisher and Roll (1969) argued that firms have the tendency to perform stock splits in period in which the market has provided the company with abnormal growth opportunities, in a few words, in time in which firms get abnormal profits.

The following chart deeply underlines this concept because instead of considering "U_m" as a parameter ,it instead isolates "U_{m+}" that represents the cumulative average residuals of split shares that offered only increasing dividends after the split has occurred :

Cumulative average residuals of shares offering increasing dividends

Figure 1.2



Source: The Journal of Finance, Vol. 25, No. 2, (May, 1970)

Stocks offering always increasing dividends indicate that the firm which in precedence issued them is experiencing a considerable well-being and growth in assets and liquidity.

Moreover, the survey suggested that 71.5 % of analyzed stocks experienced an increase in the net amount of dividend paid to shareholder in the year succeeding the split.

In front of such evidence, Fama suggested that whenever a split is announced to public, managers and directors are confident that future earnings will be sufficient to keep dividends at least at the same current level, if not higher.

Figure 1.1 and 1.2 clearly show the perfect ability of the market to react to these contingencies even before the split announcement, in such a way that, on the split day, it has already incorporated the information deriving from the announcement. On that date, stock prices have yet reacted to the directors' intention to increase the number of shares. Intention implicitly dictated by the favorable contingencies experienced by the specific company ,that not only is experiencing a period of financial health but it is also expecting to grow in the following periods, at such a rate that will

permit it to sustain an increasing dividend per share level.

However, it is not always the case that a stock split is followed by an increase in the dividend level. The opposite could also happen.

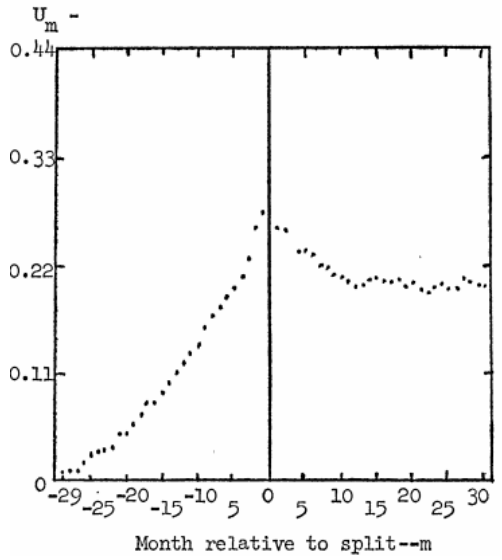
If directors, managers or insiders make wrong predictions about the future earnings the firm will achieve, after a stock split, each shareholder may also receive lower dividends due to the lack of sufficient earnings or liquidity.

Returns of such category of stocks, will act exactly in the same way as the previous category (stocks paying increasing dividends after the split day) in the time period before the split day.

At a later stage, instead, when it becomes well rendered that the firm is unable to pay higher dividends, the market will react accordingly and immediately after the split date, the rate of return will adjust to incorporate in the price level such information. It will decrease down to the level at which the stock restore again a normal relation with market returns. The graphical proof follows:

Cumulative average residuals of shares offering decreasing dividends

Figure 1.3



Source: The Journal of Finance, Vol. 25, No. 2, (May, 1970)

Note that "U_m-" represents the cumulative average residuals of split shares that offered a decreasing dividend level once the split has taken place.

Anyways, despite the difference between stocks offering increasing or decreasing dividends after a split, the sum of all cumulative average residuals (U_m) for each type of stock taken into consideration in the sample, seems to remain stable once the split has occurred as shown in figure 1.1.

Once carefully analyzed all data and charts, Fama, Jensen, Fisher and Roll deduced some important inferences: capital markets were perfectly able to react in an unbiased manner to stocks

split announcements and simply to stock splits themselves. In addition, their survey evidenced that prices tended to adjust at the end of the split month.

In conclusion, according to them, stocks market reflected a considerable degree of efficiency, in reacting to both explicit and implicit information involved in a stock split. For these motives, they finally sustained the semi-strong efficiency-form of financial markets.

1.1.3. Tests for the strong-form efficiency

A market who endures to strong form efficiency tests is a market which can be defined in just one word: perfect.

According to the literature we have at our disposal, in a strong-form efficient market, no actor has any possibility to earn superior profits despite the quality and the secrecy of the information he owns. Even if an investor possesses a monopoly over a certain type of information (public or private that those are) ,it does not consist any advantage in whatever capital market.

Niederhoffer and Osborne (1966) pointed out that specialists of the NYSE were able to gain from a certain type of information towards which they maintained monopolistic access.

The inadequacy of real capital markets to sustain strong-form efficiency tests has been clear from the beginning and for such a reason, economists, researchers and scholars instead of proving to validate the highest possible degree of efficiency in real contingencies, turned out their attention to much more adequate and pertaining issues.

Once ascertained the strong-form efficiency hypothesis is not strictly valid in real world , the most interesting questions addressed to the economic and scientific community were the ones relative to the entity of the discrepancy between returns predicted by the model an returns encountered in reality or alternatively ,if the costs incurred in acquiring monopolistic information were worth the gain .

Fama (1970) diligently disserted about these topics capitalizing on previous studies performed by Jensen (1968).

Jensen himself ,in order to build a ground above which compare what were considered " abnormal" returns with respect to what were considered "normal" instead, needed to individuate what, at that time, was the most reliable portfolios[10]' returns prediction model : namely the Sharpe(1964)-Litner(1965)'s one.

[10] A grouping of financial assets such as stocks, bonds and cash equivalents, as well as their mutual, exchange-traded and closed-fund counterparts. Portfolios are held directly by investors and/or managed by financial professionals.

The model defines returns on portfolios ($E(r_{j,t+1})$); relating them to the risk free rate[11] ($r_{f,t+1}$) ; the coefficient of each security sensitiveness with respect to market movements(β_j) and the expected return on market portfolio ($r_{m,t+1}$) ; according to the following relationship :

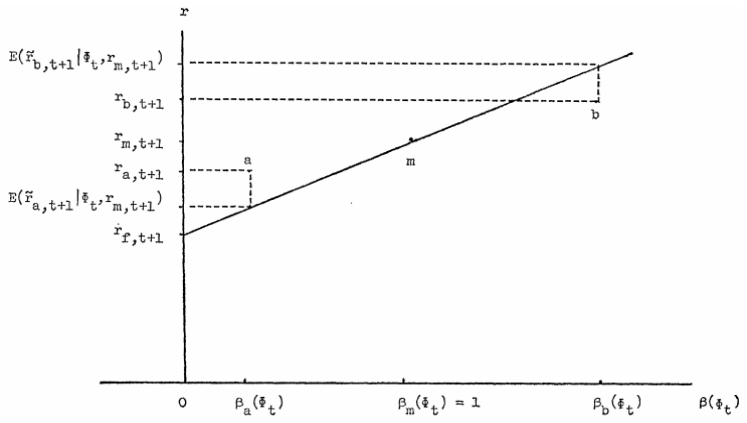
Function 1.1 $$E(\tilde{r}_{j,t+1}|\Phi_t, r_{m,t+1}) = r_{f,t+1}\,[1 - \beta_j(\Phi_t)] + r_{m,t+1}\beta_j(\Phi_t).$$

The basic idea is that the expected return on portfolio "j" , given information "Φ_t" and the return on the market portfolio, is linearly dependent to its risk.

The insights to be derived are pretty simple and intuitive: the higher the risk of a portfolio, the higher its expected return and moreover the higher the sensitiveness of the portfolio to market movements or fluctuations, the higher the risk and consequently the higher the expected return as well. To gain a better understanding, function 1.1 is plotted below in what Jensen called a " Performance Evaluation Graph":

Figure 1.4

Performance Evaluation Graph



Source: The Journal of Finance, Vol. 25, No. 2, (May 1970)

The function plotted in figure 1.4 shows all the possible combinations of returns and risk that portfolios composed by any combination of risk-free and risky assets provide investors in financial markets.

It's fundamental to realize that a portfolio which return and riskiness correspond to a point above the market line (point a in figure 1.4 for instance) offers a higher return for the same level of risk and price, hence, since it's underpriced by the market, could constitute a chance for arbitrage and as a consequence a chance for earning considerably superior profits with respect to what the

[11] The theoretical rate of return of an investment with zero risk. The risk-free rate represents the interest an investor would expect from an absolutely risk-free investment over a specified period of time.

market in normal contingencies offers.

On the other hand, a portfolio corresponding to point b, in figure 1.4, offers a lower return for both the same price and risk, hence it's overpriced and a strategy of short-selling can undoubtedly generate an arbitrage opportunity. Furthermore an underpriced portfolio constitutes an additional breach in the market strong-form efficiency hypothesis.

Moreover, it's interesting to note that the point in which the market line intersects the vertical axes is representative of the combination of risk and return offered by a portfolio only composed by risk-free assets (Treasury Bonds, T-bills, etc).

Jensen (1968) in his study, adopted the model proposed by Sharpe and Lintner (subsequently refined by Markowitz) to analyze the performance of mutual funds[12] in capital markets.

Mutual funds, in fact, can be considered the best representatives of a market agent, since they are financial institution aiming at pooling money from different kinds of investors and then investing them in securities or obligations.

Jensen was mainly interested in whether the competence and the improved knowledge owned by mutual funds ' operators allowed the mutual funds' shareholders to gain returns in excess of what the market normally granted.

The survey Jensen conducted, provided with quite contradictory results. The sample taken into consideration ,analyzed the performance of 115 mutual funds, in the time period between 1955 and 1964.

The analysis was structured at different levels of complexity and exactitude. At each level of the inquiry, influencing factors were added to let the overall survey achieve the highest possible level of accuracy.

To measure returns, Jensen adopted the ten-year (the time period he investigated in his survey) continuously compounded rate of return, and to account for risk instead, he computed the variances[13] of one-year continuously compounded rates of return for each of the ten year. The comparison term, instead, was identified in the returns offered by the Standard&Poor500[14] , a good approximation for the market portfolio.

First of all, Jensen tested whether the earnings investors received by mutual funds were such that

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[12] An investment vehicle that is made up of a pool of funds collected from many investors for the purpose of investing in securities such as stocks, bonds, money market instruments and similar assets. Mutual funds are operated by money managers, who invest the fund's capital and attempt to produce capital gains and income for the fund's investors. A mutual fund's portfolio is structured and maintained to match the investment objectives stated in its prospectus.

[13] A measurement of the spread between numbers in a data set. The variance measures how far each number in the set is from the mean. Variance is calculated by taking the differences between each number in the set and the mean, squaring the differences (to make them positive) and dividing the sum of the squares by the number of values in the set.

[14] An index of 500 stocks chosen for market size, liquidity and industry grouping, among other factors. The S&P 500 is designed to be a leading indicator of U.S. equities and is meant to reflect the risk/return characteristics of the large cap universe.

expenses in charges, fees or other administrative costs could have been justified.

In other words if ,once expenses ,uniquely incurred when investing through the intermediation of mutual funds were subtracted from net returns, they were sufficiently high to be compared, , at least with the rate of return each single investor could obtain investing on his own in a portfolio reflecting the same riskiness.

Results seemed to be clear. In about 77,39% of the cases, for a certain level of risk, mutual funds investors ,net of expenses, appeared to receive a lower return with respect to the one offered by the market (the S&P500) .

Data suggested that after 10 years, each mutual fund's shareholder got a return 14,6 % lower than the one that the market index offered.

To enhance the quality of his analysis, Jensen decided to perform the same statistical survey ignoring some expenses that a mutual fund's investor, usually, faces. In fact, when investing in mutual funds, most of the costs incurred are due to commission fees that are not directly earned by the mutual fund itself.

Jensen found it useful to adjust mutual funds' returns only to expenses directly incurred in managing the fund itself, hence adding back the overall amount of commission fees paid by investors and subtracting direct expenses only.

Again, the answer seemed to be in accordance with what the efficiency theory prescribes.

62.6 % of mutual funds in the ten-year period, were able to offer a rate of return significantly below the market average, and the mean return earned by investing in a mutual fund was registered to be 8.9% lower than the return the market index would have offered.

Even if he encountered some difficulties in collecting all the necessary information about the overall amount of expenses incurred by mutual funds (data on brokerage fees, inexplicably were not published regularly), Jensen fostered his study to the highest possible accuracy level.

Specifically, he tried to add back the sum of all expenses encountered by funds to their returns, to check whether they could be in somehow exceed the ones offered by the market.

According to these premises, results showed that the average returns for funds were 0.9% higher than the market line's predictions.

Still, this evidence, was not statistically indicative of the existence of some special information owned by mutual funds' insiders or of the fact that they had the capacity to exploit it in the most profitable way.

Indeed, at the light of the overall analysis provided by Fama and Jensen, efficiency principles seem to permeate the market structure at least in its weak and semi-strong forms .

In fact, according to the survey and data previously reported in figure 1.1 consecutive daily prices'

fluctuations are not correlated or more precisely, they seem to be positively correlated but their correlation coefficients are very close to zero; hence such a poor predictability of market movements, shouldn't allow investors to carry out trading strategies to gain superior returns and beat the market.

Furthermore, a solid empirical evidence, has shown not only that stock prices movements are not correlated but also that stock prices promptly fluctuate to incorporate all available public information. Fama, Fisher, Jensen and Roll (1969)'s survey about listed firms experiencing a stock split seems to present a clear example. The statistical significance of obtained data strengthens the validity of the semi-strong market efficiency model.

Lastly, the strong-form market efficiency model, historically, represented a more serious and articulated issue.

Anyway, the analysis Fama performed over the 115 listed firm of the NYSE offered encouraging results.

According to empirical evidence, mutual funds were not able to outperform the market, on the contrary, investors that had to account for expenses, typically and strictly related to this kind of financial intermediaries, were rewarded with a rate of return that for most of the cases was lower than the rate of return that the market would have provided, if the investor had individually invested in a portfolio with the same risk-level.

On the other hand, a lot of literature, denying the weaknesses of the strong-form efficiency model, does exist and a lot of experimental proofs have been furnished to underline its weaknesses.

Particularly, evidence of the strong-form inefficiency, was provided by Niederhoffer and Osborne (1966) whose studies were deeply analyzed by Fama. Their surveys, indeed, suggested some interesting facts:

- Reversals (consecutive price changes with opposite sign) were 2 or 3 times more likely than continuations (consecutive price changes with same sign).
- A continuation is statistically more recurrent after a previous continuation than after a reversal

Niederhoffer and Osborne were able to provide the scientific community with a rigorous explanation of such inefficiency, to be traced in the structure of the New York Stock Exchange, from which data, stocks prices and returns were sampled.

In this kind of exchanges, investors have the possibility to place three kinds of orders on a certain stock: the buy limit[15] , the sell limit[16] and the “buy or sell at market “[17]order.

[15] An order to purchase a security at or below a specified price. A buy limit order allows traders and investors to specify the price that they are willing to pay for a security, such as a stock. By using a buy limit order, the investor is

The set of all non-executed orders is kept by the devotee to the issue of executing them on the floor of the stock exchange.

By definition, non executed sell limit orders have to lay at higher prices than unexecuted buy limit orders. On both of them, the smallest positive (in absolute terms) allowed price change is 1/8=0.125 points and on the floor there are more than one non-executed sell limit order at the lowest possible price for each one . A transaction completed at this price (caused by the order of buying at market) can only be succeeded by a deal closed at an identical price (assuming the next market order is to sell) or alternatively by a deal concluded at a lower price (assuming the next market order is instead to buy).

The argumentation explains why usually price increases are followed by succeeding price increases and vice versa why price decreases are usually followed by others price decreases.

When consecutive "buy limit orders" drains all the "sell limit orders" at a determined price, each transaction contributes to the rising price of the considered stock and as a consequence, consecutive price increases takes place.

It's relevant to recall that the results of the empirical research conducted by the two economists, surely hurt the basic structure of the Market Efficiency Hypothesis, but just in its strong-form.

Specialists, who own the list of unexecuted orders in their books, possess a considerable amount of information regarding the future behavior of prices and as a consequence the possibility to profitably exploit from this relevant information and beat the market.

Nevertheless, the market grants this opportunity only to specialists, who can be considered insiders, because of the fact that they own what is intended to be "private information" : information that is not available to public. For this specific reason, Niederhoffer and Osborne's inspection damaged the strong-form market efficiency concept.

They basically pointed out that specialists on major security exchanges have monopolistic access to information and they could ,exploiting them ,generate trading profits.

In addition, Scholes (1972), found that corporate insiders have access to monopolistic information regarding their firms that can be utilized to gain advantage with respect to those investors who can only rely on available public information.

Not surprisingly, profitable trading strategies may arise from insider trading.

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guaranteed to pay that price or better, meaning that he or she will pay the specified price or less for the purchase of the security.

[16] An order to a broker to sell a specified quantity of a security at or above a specified price (called the limit price).

[17] An order that an investor makes through a broker or brokerage service to buy or sell an investment immediately at the best available current price. A market order is the default option and is likely to be executed because it does not contain restrictions on the buy/sell price or the timeframe in which the order can be executed.

By the way, corporate insiders and specialists are the only two categories to which monopolistic access has been allowed, documented and proved.

In conclusion, even if the strong-form market efficiency level seems not to find a concrete validation in reality, its main principles have assumed a concrete relevance as a comparison term.

The level of market inefficiency, indeed, may be measured as the difference of returns offered by the inefficient market and returns offered by the theoretical strong-form efficient market.

Finally, Fama (1970) argued that the evidences in favor of the Market Efficiency Hypothesis are much more than those against it, meaning that the theory reflects a good approximation of the reality.

Anyways some tangible deviations do exist and will be discussed at a later stage.

1.2. How to measure the market degree of efficiency? An analysis of the CAPM

As can be noticed by the discussion developed in paragraph 1.1, the degree of efficiency in financial markets is defined in terms of rate of returns and more precisely in terms of the discrepancy between actual rates of return and rates of return predicted by a reliable and effective model. Historically, the model that mostly convinced economists and investors due to its effectiveness and exactitude was the Capital Asset Pricing Model, initially elaborated by Sharpe (1964) and Lintner(1965) ,still employed nowadays.

The Capital Asset Pricing Model, as sketched earlier, is a model that implies the equilibrium condition in financial markets. It was firstly proposed by William Sharpe (1964) and subsequently developed by Lintner (1965) and Mossin (1966) thanks to their independent studies. Subsequently, H. Markowitz implemented the model , defining all the pertaining criteria of portfolios' selection. He also won the Nobel Prize in 1990 thanks to his contribution, along with Sharpe and Miller.

The main implication of the CAPM is that the contribution of whatever financial asset to the variance of market prices , represents the exact measure for defining the asset's risk and moreover it is the main determinant of the asset's rate of return. The basic relation is the following:

$$r_i - r_f = \beta_i (r_m - r_f) ,$$

where "r_i "stands for the return of asset "i" , r_f is the risk-free rate , r_m is the market rate of return and β measures the price sensitiveness of the specific asset with respect to market fluctuations. β is called "systematic risk factor" and it is analytically defined as $\beta = Cov(r_i, r_m)/Var(r_m)$. Furthermore, $r_i - r_f$ stands for the security risk premium while $r_m - r_f$ for the market risk premium.

One important assumption of the CAPM is that expected residual returns on portfolio "i" are zero and it implies that $E[r_i]=\beta\ E[r_m]$. Returns on financial assets are directly proportional to **β**,to the systematic risk factor. The theoretical implication of this analysis of the CAPM is basically that investors should receive a premium in terms of returns because of their willingness to acquire risky assets. In a certain way, they must be rewarded for the risk they decide to bear.

In perfect capital markets, the CAPM should be always successful in predicting assets' returns. When a market is perfectly efficient, the model should be able to capture all the asset's fundamentals in such a way to predict the exact and fair rate of return. Most of the times, the model works like this: the predictions it furnishes are quite adequate. Some other times, the model doesn't seem to properly fit the contingencies due to some variables that react in ways it is not constructed to manage. Some studies attempted to demonstrate the inadequacy of the coefficient **β** in reflecting the real sensitiveness of the specific portfolio to fluctuation of the market portfolio.

It seems, in reality that some influencing factors are not taken into account by the model that, as a consequence, furnishes incorrect predictions.
In particular, many experiments have been conducted by Simon G.M. Koo and Ashley Olson (2014) from the Department of Mathematics and Computer Science of the University of San Diego (CA), with respect to this specific issue. They structured their analysis approximating the market with the S&P500 and collecting all necessary data from 288 traded public companies' documentation, from the 1st of November 2005 to the 1st of November 2006. The time period during which the sample has been analyzed, was exactly one year.
In order to perform a robust analysis, each company included in the sample was selected among the most financially solid companies. Specifically, each company of the sample, had to reflect a price earnings ratio[18] lower than 10 , a positive profitability index[19] and moreover a market capitalization exceeding 500 million dollars. Successively, Koo and Olson subdivided all the 288 sampled companies into forty-eight portfolios; each one containing six stocks and constructed to show a different degree of risk and a different corresponding value of beta. Sixteen out of forty-eight

[18] A valuation ratio of a company's current share price compared to its per-share earnings. Calculated as: Market Value per Share / Earnings per Share (EPS)

[19] An index that attempts to identify the relationship between the costs and benefits of a proposed project through the use of a ratio calculated as: PV of future Cash Flows/ Initial Investment

portfolios were built to display a beta value of 0.5, and they were treated as the low-risk portfolios (Group A). Sixteen portfolio were assembled to reflect, instead ,a beta value near to 1 and they were considered the average risk portfolios (Group B), while the remaining sixteen portfolios were arranged to show a beta value of 2 (each portfolio amplifies any market fluctuation) and thus they were considered to be the high risk portfolios (Group C) .The aim of the survey was to confirm whether the structure and the fundamentals of beta as a unit of measure were able to detect all the portfolio fluctuations due to market movements and if the CAPM provided with reliable results. Stated analytically, the two scholars attempted to demonstrate the following hypothesis:

- (Group A , beta=0.5) $H_0 : r_a=0.5*r_m$
- (Group B , beta=1) $H_1 : r_b=r_m$
- (Group C , beta=2) $H_2 : r_c=2*r_m$,

where r_m is the average market return, while r_a,r_b and r_c represents the average return respectively of portfolios belonging to group A, portfolios belonging to group B and finally portfolios belonging to group C.

The results they obtained were not so much indicative of the correctness in prediction of portfolios returns through the employment of beta as the main indicator. Results for hypothesis testing are displayed in the following table:

Results for beta-reliability testing

Table 1.2

	Group A	Group B	Group C
μ_i	0.167	0.087	0.078
s_i	0.372	0.119	0.115
t_i	0.266	0.423	1.712
p-value	0.206	0.322	0.893

Source: Capital Asset Pricing Model Revisited: Empirical Studies on Beta Risks and Return Simon G. M. Koo and Ashley Olson

Hypothesis were tested adopting the Student's t test[20] methodology and large numbers for p-

[20] A *t*-test is any statistical hypothesis test in which the test statistic follows a Student's *t* distribution if the null hypothesis is supported. It can be used to determine if two sets of data are significantly different from each other, and is most commonly applied when the test statistic would follow a normal distribution if the value of a scaling term in the test statistic were known. When the scaling term is unknown and is replaced by an estimate based on the data, the test statistic (under certain conditions) follows a Student's *t* distribution.

values[21] are indicative of existence of too much information not to validate and hence to reject all the three hypothesis. Furthermore it can be seen from the table, that for smaller values of beta, the CAPM performs quite well in predicting returns, but as long as the beta value increases and the portfolio becomes more risky, predictions becomes always worse. Any investor, choosing one of the sixteen portfolios with an higher beta, in 89.3% of the cases will end up with a portfolio that does not exhibit the expected rate or return or equivalently that exhibit a too low rate of return for that specific risk-level.

The main inference to be derived is that the CAPM does not succeed in accurately forecasting actual returns. Therefore, the main question that arise is whether the CAPM is inadequate in estimating returns of portfolios belonging to perfectly efficient markets or, if alternatively, real markets aren't perfectly efficient and forms of empirical inefficiencies could bias the CAPM estimations. The issue will widely debated in the third chapter where an alternative explanation for the Small Firm Effect will be provided, based on the intrinsic structure of the CAMP and its flaws.

1.3. Do investors behave efficiently in financial market's environments? An introduction to Behavioral Finance

One of the most relevant issue in analyzing the quality and the degree of efficiency of a market system, is verifying whether actors within the system, act according to principles of utility maximization and rationality. Over time, experiential evidence has shown that occasionally, humans do not act the way economic principles prescribe them to. Statistically significant evidence demonstrated that ,whenever choosing, investors are influenced by factors that are not accounted in past economic models of efficiency analysis or utility maximization ,like the ones delineated by Morgensten & Von Neumann (1944).

In recent years, the contamination of different disciplines, has given the birth to a new subject of matter : namely, Behavioral Finance. The goal this new field of research, resides in

[21] In statistics, the *p*-value is the probability that data at least as surprising as the observed sample results would be generated under a model of random chance (determined by the null hypothesis). It depends both on the method of quantifying surprise and the specific model of random chance. The *p*-value is a function of the data (a statistic).In the context of statistical hypothesis testing, before performing the test a threshold value is chosen, called the significance level of the test, traditionally 5% or 1% [1] and denoted as α. If the *p*-value is equal to or smaller than the significance level (α), it suggests that the observed data are inconsistent with the assumption that the null hypothesis is true, and thus that hypothesis must be rejected and the alternative hypothesis is accepted as true. When the *p*-value is calculated correctly, such a test is guaranteed to control theType I error rate to be no greater than α.

understanding, documenting and justifying all the choices that investors perform but do not reveal economic rationale behind them and hence belong to the irrational field . Sometimes, choices that do not perfectly fit rationality principles are dictated by others factors that classical and neoclassical models were not able to consider; namely emotions and psychological conditioning elements.

One of the first scholars that acknowledged the fact that financial actors were not perfectly efficient was Richard Thaler (1994). He stated that, in order to find the solution to an empirical puzzle, it is necessary to entertain the possibility that some of the economic agents behave less than fully rationally, some of the times. Furthermore, Jay Ritter Cordell (2002), professor of Finance at the University of Florida , disjoined Behavioral Finance in two separate constituents : cognitive psychology and the limits to arbitrage. The term "cognitive" refers to the way individuals think and take decisions. A lot of proofs have been provided, evidencing that individual choices are often dictated by factors such as overconfidence or overreliance on past experiences. Tastes and preferences are influencing factors as well. On the other hand "limits to arbitrage", refers to the boundaries of inefficiency, arbitrage's forces can set and dictate.

The main building block on which the Behavioral Finance is based is the employment of models in which investors are not fully rationale, because in reality, they're not. One of the most shining examples in which this concept is stressed, is the one concerning the reaction of an individual investors with respect to a 2$ gain compared to the reaction of the same individual to a loss of 1$. According to Cordell : "*people are loss averse - a $2 gain might make people feel better by as much as a $1 loss makes them feel worse. Mistaken beliefs arise because people are bad Bayesians.*"(Cordell, 2002, p. 6)

The main innovation Behavioral Finance contributes to economic sciences, is that while the Efficient Market Hypothesis suppose that financial markets are efficient and able, in an unbiased way , to predict future prices ; on the contrary, it is based on the concept that most of the times, markets are inefficient in absorbing information.

One of the most important roles in financial markets is attributed to arbitrageurs[22], whose main task is eliminating all the possible profit opportunities, in such a way to maintain the price of whatever security stuck to its fundamentals. Arbitrageurs, usually buys undervalued securities or short-sell overpriced ones, in such a way to earn a risk-less profit thanks to the price differential.

[22] A type of investor who attempts to profit from price inefficiencies in the market by making simultaneous trades that offset each other and capturing risk-free profits. An arbitrageur would, for example, seek out price discrepancies between stocks listed on more than one exchange, and buy the undervalued shares on one exchange while short selling the same number of overvalued shares on another exchange, thus capturing risk-free profits as the prices on the two exchanges converge.

They are able to do so, only if markets react in an unbiased manner, that is if prices are expected to converge to fundamentals in the short run. If it might be the case that prices are not certainly expected to converge to fundamental values in short times, arbitrageurs may also decide not to undertake such transactions, simply because price volatility and risk are too high . If it is the case, arbitrageurs, in the role of efficiency's guarantors, fail in the purpose.

The way individual investors act and perform in the market was and it is still nowadays subject of research of a lot of psychologists whose principal aim is to trace the behavioral guidelines of these investors, trying to contextualize their strategies and actions. According to Cordell, most of the times, actors in financial markets behave following a rule of thumb or Heuristic[23] pattern. This pattern, lead to easier and more reachable solutions but the deriving investment decisions, may be even defined suboptimal. Benartzi and Thaler (2001) demonstrated that whenever facing N opportunities for investing their retirement money, more or less each retiree invests an amount 1/N of money in each of the available investment opportunities. Even if this logic may appear straightforward just for a logic of diversification, the proportions according to which money should be invested should also follow a risk/return rationale. Investing an equal part of available funds in each of the accessible investment opportunities, denotes overconfidence and misjudgment of the diversification principle.

Always for the above mentioned reasons, people tend to under-diversify , commonly because they over-rely on firms they know quite well. This is one of the reasons why managers own so much securities of the company they manage. They're usually confident in their skills and ability as managers and they over-rely on the fact that the company will show economic growth and increasing profits in the future.

Furthermore, interestingly enough, Barber and Odean (2001) discovered that, on average, women are less confident than men. The empirical proof of such inference is in the carefully analysis the two economists performed over the amount and the entity of trading activities engaged by the two groups under consideration. The basic rationale is that, since people tend to be overconfident, they also tend to invest more and in more different ways. Since the great majority of beliefs owned by overconfident investors are statistically unreliable or simply incorrect, the more they trade the more they lose. Barber and Odean asserted that according to their survey, men tend to

[23] A heuristic technique ,sometimes called simply a *heuristic*, is any approach to problem solving, learning, or discovery that employs a practical methodology not guaranteed to be optimal or perfect, but sufficient for the immediate goals. Where finding an optimal solution is impossible or impractical, heuristic methods can be used to speed up the process of finding a satisfactory solution. Heuristics can be mental shortcuts that ease the cognitive load of making a decision. Examples of this method include using a rule of thumb, an educated guess, an intuitive judgment, stereotyping, profiling, or common sense.

be more overconfident and hence to trade more and perform worse than women.

Another interesting phenomenon Cordell mentioned in his brilliant paper is "*Mental Accounting*". Humans tend to separate purchasing decisions and isolate them even if they're strongly correlated. It's pertaining to human behavior to care about food expenditures in domestic contexts and be big spenders in restaurants. It's a typical behavior to spend for a prized cut of meat at restaurant than to buy the same cut of meat for home consumption, even if the contrary would be much less expensive and consequently under a utility maximization point of view would be much more effective and rational. Nevertheless, this phenomenon commonly occurs and the reason for this, is that people in reality tend to differentiate different contexts and to take decisions accordingly. They seem not to be able to trace the links connecting the two expenditure areas; in fact empirical research showed that human brains sometimes work for sealed compartments.

The "*Framing phenomenon*", instead, is certainly connected to the perception humans have of different circumstances. In effect, business people, tend to promote discounts at off-peak times rather than surcharges at peak periods. Even if , the price list, would be exactly the same. The same applies for doctors who have to prescribe recommendations to their patients. Cognitive psychologists showed that doctors have the tendency to prescribe different recommendations if the evidence they analyze is in the form of "survival probabilities" rather than "mortality rates". Rationally, this makes no sense since the survival probabilities and the morality rates have to sum up to 1. They reflect complementary portions of the same pie. Daniel Kahnem and Amos Tverskyan (1979) in the second half of the XX century, conduced a pioneering research about psychological biases ,defining them as the inevitable process of selective influence on the perception of the meaning an individual attributes to words or sentences.

In the early 1970s the two scientists also defined the concept of the "*representativeness heuristic*" defined as : *"the degree to which an event is similar in essential characteristics to its parent population, and reflects the salient features of the process by which it is generated."* (Daniel Kahnem and Amos Tverskyan , 1970, p.1125). Also known as the law of small numbers, the representativeness heuristic indicates that, people are usually inclined to underestimate long-term averages. Particularly, investors tend to focus on recent trends and stock exchange's paces rather than on the long-run behavior of financial markets.

"When equity returns have been high for many years (such as 1982-2000 in the U.S. and Western Europe), many people begin to believe that high equity returns were normal."(Ritter Cordell,2002 ,p. 6)

In contrast to what the representative heuristic prescribes, people sometimes show themselves conservative, in the sense that they adapt slowly to new changes , in order to remain anchored to previous cornerstones. This principle is known as "*Conservatism*". Cordell asserted that, at first, when things have just changed, people tends to under-react according to the conservatism's principles, but once that people have the possibility to cover the path indicated by the change, they adjust toward that specific change and remain stuck to it, even overreacting, as the representativeness heuristic bias prescribes.

One of the major evidence of investors acting in irrational way is exemplified by the "*Disposition effect*" . This term has been coined by Shelfrin and Statman (1985). The two economists, based their study on a previous research performed by Schlarbaum, Lewellen and Lease (1978). Analyzing data from 2500 individual investors' performances from 1964 to 1970 Shelfrin and Statman obtained interesting results. They computed the returns those investors realized by buying and subsequently selling stocks of their portfolio, ignoring all the acquisitions of stocks that were not sold in the following periods. According to analyzed data, investors were able to outperform the market and earn a return 5% higher. Moreover, more than 60% of trades resulted in profits. Since both market timing and risk factors seemed not to have affected the computations performed by the two economists they concluded that the realized returns were disproportionally high due to unexpected stock's value increases that encouraged investors to sell them in order to realize a huge net return while stock which underperformed or decreased in value were kept in the investors' portfolios. This is because irrational investors are reluctant to sell a stock they have bought if it decreases in value, even if there is a consistent probability that its price will continue to follow its decreasing path. Shefrin and Statman concluded that investors are reluctant to realize their losses and accordingly, they usually realize a lot of small gains and few big losses, but in principle it doesn't mean that they're maximizing their utility. In fact, being rationale and realizing that eventually a certain stock would scarcely recover its original value, due to external factors, and hence sell it, is the best move to increase returns and trade a larger volume of securities.

Anyways, the most relevant issue of behavioral finance probably remains its reliability. It's a science based on the predictability of irrational attitude of investors or individuals. By definition however, precisely predicting what is irrational and specific to each one individual or investor is quite impossible. Scholars of the caliber of Thaler, Barberis and Hirshliefer tried to deal with these difficulties and to furnish the guide lines according to which a particular behavioral bias will dominate another in a given circumstance. Results, however, were not particularly satisfying and in addition, are not the core of this dissertation.

1.3.1. A concrete application

Among all the possible applications, Behavioral Finance has in capital markets, one of the most interesting is the one relative to the valuation of firm's equity which highlights the undeniable influence of the ,previously debated, "*Framing Phenomenon*" whenever dealing with stocks. Cordell (2002) in particular, in its analysis .presented an hypothetical company ,reflecting the following accounting features :

Revenue	$1,200,000
Cost of Goods Sold	$600,000
Administrative Expenses	$400,000
Interest Expense	$200,000
Taxes	$0
After-tax profits	$0
Debt	$2,000,000
Book Equity	$1,500,000
Shares outstanding	10,000
Interest rate on debt	10%

He moreover assumed that the inflation rate was fixed at 6%, the nominal cost of capital was 10% since the real cost of capital stayed at 4% [24]and that the company aimed at maintaining the real value of its debt constant. Consequently, the nominal amount of debt had to be increased by 6% every year due to inflation. Furthermore the company was not assumed to grow in real terms, hence g=inflation rate =6%. Finally any eventual free cash flow was paid out as dividends to shareholders.

According to the above mentioned assumptions, if the company's target was to maintain the real amount of debt fixed, it had to issue $2,000,000*6%= $120,00 of new nominal debt the following year. Furthermore, as suggested before, any income was paid out as dividends. Recalling that g=6% and that the nominal cost of capital (r) was 10% we can apply the growing perpetuity formula to compute the firm share's value:

$$P_0=DIV_1/(r-g) = 12/ (0.1-0.6) = \$300 \text{ per share}$$

Note that DIV_1 = $12 Since by assumption the company owned 10,000 outstanding shares .

To compute the dividend for the following year ,the amount of new debt issued, paid out as dividends, had been divided by the number of outstanding shares : $120,000/10,000=$12. According to accounting principles, earnings were zero because nominal interest expenses were treated as a cost but on the other hand the devaluation of the real debt induced by the inflation was

[24] Nominal cost of capital=real cost of capita+ inflation rate

not treated as a benefit to shareholders. In principle real economic earnings are higher than accounting earnings because accounting measures do take account of the debt financing costs but simply ignore the benefit to shareholders due to the high inflation level. Cordell asserted that equity are undervalued in cases of high inflation and overvalued, instead, when inflation is extremely low. A clear expression of the "*Framing*" phenomenon.

As long as the inflation rate increases, equities become always more and more undervalued and the stock riskier, because its price falls at a rate that is not justified by the firm's fundamentals . The other way around, occurs when inflation is low. As Siegel (1998) demonstrated, these two effects offset themselves in the long run and this is one of the reasons why stocks are less risky if held for long time period. In conclusion, according to authors that deeply discussed this recently indentified area of research, such as Cordell, Thaler, Shiller, Shelfrin and Hirshliefer ; capital markets reveal a considerable degree of efficiency, while investors do not . Humans' behavior, most of the times is far from being rationale due to factors that lie outside the strictly economical and financial area. The role of arbitrageurs ,for instance, is crucial in financial markets, because whenever profit opportunities arise due to price misjudgments , arbitrageurs driven by the desire of maximizing their utility are immediately able to identify those opportunities and eventually buy undervalued equities while short-selling[25] overvalued ones in order to benefit from the superior returns and thus eliminating every profit opportunity. Whenever every possibility to beat the market and earn superior profits is eliminated, it means that markets in that specific contingency are correctly pricing all assets that are traded within them and hence are working efficiently. Whenever instead arbitrageurs are not able to identify misjudgments in prices because of cognitive biases or behavioral influences; market prices do not correctly reflect equities' fundamentals and as long as those profit opportunities are not eliminated, capital markets continue to distance themselves from a concrete degree of efficiency and a proper functioning. Behavioral Finance, aims at identifying and describing the reasons why and the contingencies in which those phenomena occur. It's aimed at tracing the link between irrational conduct and psychological attitude, in order to reveal and justify those inefficiencies that in real markets do persistently exist.

Anyways ,in agreement with what recent theories have been supporting, financial markets are not intended to remain partially inefficient forever. Instead they will continue to refine themselves through a process of natural selection of both investors and traded securities. In the long

[25] The sale of a security that is not owned by the seller, or that the seller has borrowed. Short selling is motivated by the belief that a security's price will decline, enabling it to be bought back at a lower price to make a profit. Short selling may be prompted by speculation, or by the desire to hedge the downside risk of a long position in the same security or a related one. Since the risk of loss on a short sale is theoretically infinite, short selling should only be used by experienced traders who are familiar with its risks.

run the results will be: completely efficient financial markets and perfectly rational investors. The theory that more strongly sustains this supposition is the “Adaptive Market Theory” ,argued by Daniel and Titman (1999) and Lo (2004) and that will be the core of the next paragraph.

1.4. The connection point between efficient markets and Behavioral finance : The Adaptive Market Hypothesis

Andrew W. Lo in his Ph.D. dissertation thesis argued “*the battle between proponents of the Efficient Markets Hypothesis and champions of be-havioral finance has never been more pitched, and little consensus exists as to which side is winning or the implications for investment management and consulting.[..]I reviewed the case for and against the Efficient Markets Hypothesis and described a new framework : the Adaptive Markets Hypothesis, in which the traditional models of modern financial economics can coexist alongside behavioral models in an intellectually consistent manner. Based on evolutionary principles, the Adaptive Markets Hypothesis implies that the degree of market efficiency is related to environmental factors characterizing market ecology such as the number of competitors in the market, the magnitude of profit opportunities available, and the adaptability of the market participants.”*(Andrew W. Lo,2005,p.1)

He basically identified a new model that permits the coexistence of both the Market Efficiency and Behavioral Finance theories altogether. The joint application of different areas of research, namely economics and biology allowed a lot of inefficiency that had been noticed in financial markets, to be realized and studied under a different viewpoint. The main rationale is that all the violations of the rationality principle reported by behaviorists, are simply evaluated as necessary phases of an evolutionary process that in the long-run will possibly clear markets from all their imperfections.

Nevertheless Lo, wasn't the first scholar who combined biology and economics. First of all, Malthusc(1798) was convinced that population increased at a geometric rate while food and other natural resources only grew following an arithmetic path. Schumpeter (1939)'s business cycle theory as well, was pregnant of such contaminations. Anyways the first who proposed a theory similar to the Lo's one was Niederhoffer (1998) when he published “The Ecology of Markets”. He

basically compared every financial market to a specific ecosystem and, in particular, dealers[26] to herbivores, speculators[27] to carnivores and floor traders[28] to decomposers. Lo inspired by Niederhoffer's deductions , formulated a comprehensive and organic "Adaptive Market Theory". At the base of his system there was a concept espoused by the Nobel Prize economist Herbert Simon (1982); the concept of "bounded rationality". According to this principle, individuals are not fully able to maximize their own utility, or stated differently they would like to, but they do not know how. Furthermore, Lo argued that the process of optimization revealed itself expensive and exhaustive. Consequently, individuals become content to achieve what is defined a "satisfying" level of utility. Choices people do, are not utility optimizing but instead utility satisfying. Lo, was however aware of the difficulty in establishing what could be a satisfying utility level and reached the conclusion that humans do not possess the analytical tools to compute this level; otherwise they would be utility optimizers. On the other hand, he was convinced of the fact that a satisfying utility level must be indentified through attempts and misjudgments. In such a way a process of natural selection would start to eliminate those behaviors that individuals adopt and that are not beneficial in a particular environment. According to Lo, the pillars upon which the entire Adaptive Market Hypothesis should be built are the following:

- Individuals are selfish and may be eventually erroneous.
- Individuals are able to mute their habits in order to adapt.
- Competitive markets drive the selection and innovation process.
- Natural selection defines the features of the environment.
- The evolution process determines the dynamics of all market's transactions.

Lo was aware of the fact that even according to the Market Efficiency Theory individuals act in their self interest. The main difference is that, since they're rationale by nature, they're also not allowed to make mistakes or misjudgments. Furthermore, whereas the Market Efficiency Theory

[26] A person or firm in the business of buying and selling securities for their own account, whether through a broker or otherwise. A dealer is defined by the fact that it acts as principal in trading for its own account, as opposed to a broker who acts as an agent in executing orders on behalf of its clients. A dealer is also distinct from a trader in that buying and selling securities is part of its regular business, while a trader buys and sells securities for his or her own account but not on a business basis.

[27] A person who trades derivatives, commodities, bonds, equities or currencies with a higher-than-average risk in return for a higher-than-average profit potential. Speculators take large risks, especially with respect to anticipating future price movements, in the hope of making quick, large gains.

[28] An exchange member who executes transactions from the floor of the exchange exclusively for his or her own account. Floor traders used to use the "open outcry" method in the pit of a commodity exchange, but now most of them use electronic trading systems. They fulfill an important role in commodity and stock market by risking their own capital to trade futures, options or stocks, thereby providing liquidity and narrowing bid-ask spreads.

considers individuals as if they own all the necessary means to fit the environment without any room for mistakes ,the Adaptive Market Hypothesis considers the adaptation process, crucial for the evolution of the entire ecosystem, considered as the combination of both actors and the environment they live. One of the critical points of the system ,Lo defined, is that competition is synonym of efficiency. The more a market or an environment is populated and scarce in resources, the more it will be competitive because of its participants' need to grab resources in order to survive. These competitive interactions cause the stronger species or the best attitude to survive while the weakest species along with the unsuitable behavior are doomed to extinguish. In addition, as long as certain species become extinct, due to radical shifts in environmental conditions, or due to the exhaustion of food resources, the market gains in efficiency terms. Investors who survive to uncomfortable conditions are the ones that behave more rationally than the ones who extinguished. The natural selection process allows the market to become always more and more efficient. Nevertheless, the achievement of a final equilibrium is not guaranteed at all. Sometimes this equilibrium simply does not exist and some other times it does exist but the convergence rate towards it, may be extremely low such that it's meaningless to consider it. Hence according to the Adaptive Market Hypothesis, in certain contingencies trading strategies prove effective and profitable while in others they prove counter-productive in relation to the conditions of the always changing environment, the magnitude of actors joining and leaving the industry and the entity and amount of profit opportunities. Whenever the financial markets' characteristics change, so will do the investors' population in order to fit at best the new turned environment. To sustain the above asserted inferences, Lo reported the example of the "fixed-income relative value hedge funds[29]" : their number considerably decreased in 1998 due to complete failures, investors' redemptions and the lack of a consistent number of start-ups in this specific financial sector. Anyways, a new recent tendency towards a considerable rise in number of these kinds of financial institutions is indicative of the fact that their performances have clearly ameliorated.

1.4.1. Reasonable applications

At the light of the conclusions traced earlier, it seems logical to assert that the concept of

[29] Hedge funds are alternative investments using pooled funds that may use a number of different strategies in order to earn active return, or alpha, for their investors. Hedge funds may be aggressively managed or make use of derivatives and leverage in both domestic and international markets with the goal of generating high returns (either in an absolute sense or over a specified market benchmark). Because hedge funds may have low correlations with a traditional portfolio of stocks and bonds, allocating an exposure to hedge funds can be a good diversifier.

perfect capital markets provided by the Efficiency Market theory can be considered a sort of a steady state of the market itself, under the Adaptive Market Hypothesis' perspective: a final stage that the market will probably reach in the long-run through a process of natural selection and enhancement. On the other hand the market dynamics described by Behavioral Finance, according to the Adaptive Market Hypothesis, simply represent isolated phenomena that a particular market faces during his evolutionary path. However, it is crucial not to model economic realities according to behavioral principles only. In order to build a realistic model of financial markets, it's essential to exploit mathematical and analytical tools: the ones provided by the Efficient Market Hypothesis. The coexistence of behavioral and perfectly analytical interpretations permits the Adaptive Market Hypothesis to furnish a more comprehensive and realistic model of reality. For this specific reason, the Adaptive Market Hypothesis has provided with a lot of concrete e useful real applications related to investment management and consulting.

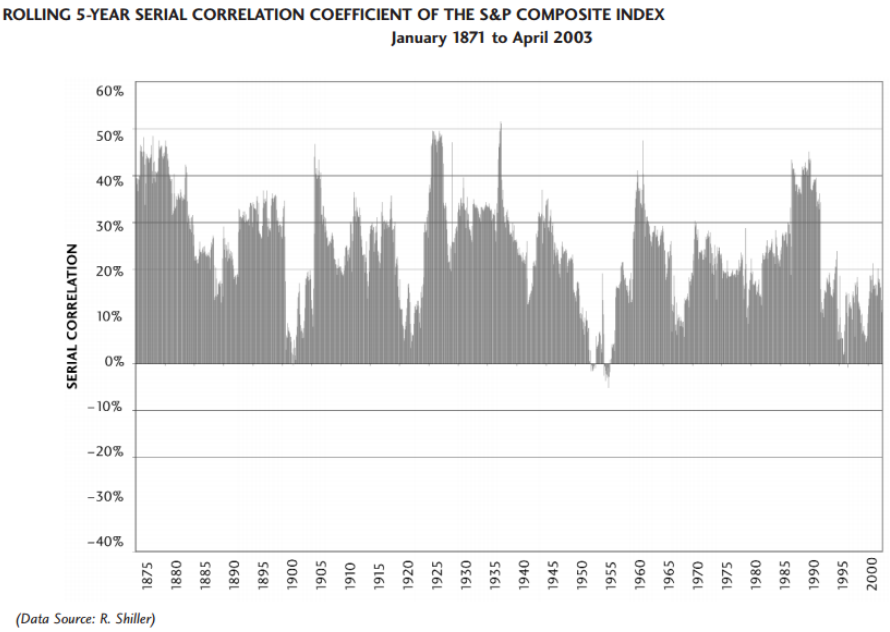
The first one application that the Adaptive Market Hypothesis furnishes, is mostly concerned with preferences and the way they're computed, evaluated and accounted.The Efficient Market Hypothesis considers preferences as given: each individual owns his personal utility function and every transaction he or she enters is functional to utility maximization only. No other purposes are involved. The Adaptive Market Hypothesis instead, takes into account much more variables. In particular, each economic actor's preference may sometimes be automatic responses of the limbic system, while some other times they may be the output of a semi-rational reasoning process arbitrated by the prefrontal cortex. In these circumstances, preferences are not given and in addition they're dependent to time periods and each individual emotional condition. The concept of utility maximization is inevitably overshadowed by such factors, even if, as argued before, each individual aims at reaching a satisfactory utility level.

The second application is linked to the "*asset allocation*" analysis. Lo, based on his findings, asserted that the relation between risk and reward does exist, as suggested by the Efficient Market Hypothesis, but it is unlikely to remain stable over time due to the always changing dynamics of the financial ecosystem . Natural selection redefines and reshapes aggregate risk preferences over time. Furthermore, differently from what is implied by the Efficient Market Hypothesis, arbitrage opportunities do exist. More specifically, Grossman and Stiglitz (1980) were convinced of the fact that these opportunities represent incentives for investor in the price-discovery process. Without such incentives, the entire system would collapse. In the ecosystem described by the Adaptive Market Hypothesis, trading strategies will be profitable according to a cyclical trend. Strategies aimed at profiting from arbitrage opportunities will be much more effective in the beginning, when the arbitrage opportunity has been just discovered and it will become much less

profitable as other investors become aware of such opportunity and apply the same tactics. Over time, that specific trading strategy will be played always less frequently, until it regains profitability when environmental conditions, once evolved, are again suitable for such types of trades.

The presence of arbitrage opportunities in a market is synonymous of market inefficiency. The more a market is efficient the more its stock prices follow a random walk and the correlation between price changes from one day to the next approaches zero. The following graph showing autocorrelation[30] of prices for the S&P500 from January 1871 to April 2003 clearly shows the cyclicality of the pattern according to which capital markets reveal efficiency fundamentals:

Figure 1.5 *Serial correlation coefficient of the S&P500 from 1875 to 200*



Source: R.Shiller

It appears clear that the efficiency degree varies according to a cyclical fashion. Furthermore, better analyzing the chart (figure 1.5), the inadequacy of the Efficient Market Hypothesis in explaining dynamic changes in market conditions, is evident. The Efficient Market Hypothesis, in fact, is a static model, in which markets are given as perfectly efficient; nevertheless empirical evidence proved something different. It can be noticed that the serial correlation even if in a cyclical fashion are decreasing over time and it can be seen as a clear example of progress and gain in efficiency.

[30] The same as serial correlation.

The final application of the Adaptive Market Hypothesis, concerns the role of innovation and adaptation, intended as the primary targets to achieve in order to survive and fit at the best the evolving environment. For these motives investments management and consultant have to constantly beat the competition to continue performing and enjoy profits. Flexibility and ability to adapt can make the difference in financial markets.

1.5. Summary

The first chapter of this dissertation thesis aimed at presenting and analyzing in detail the Efficient Market Hypothesis, its structure, features and derivative theories. Thanks to Fama's surveys and contribution we're now able to compare reality with what the Efficient Market Hypothesis asserts. The results seemed to confirm that, up to a certain degree of reliability, reality reflects efficiency principles, in particular for what regards the randomness of prices behavior. Experiential tests were performed at three level, relative to each one of the three corresponding degrees of efficiency: the weak-form , the semi-strong-form and finally the strong-form efficiency level. Anyways Fama himself, thanks to a carefully analysis of past literature and past scholars' studies , acknowledged the existence of certain phenomena that were far from reflecting financial markets' efficiency and people's rationality. In particular, he acknowledged the ability that stock market's specialists owned in gaining superior profits; but he wasn't that much concerned with these kinds of peculiarities.

Since the results of the empirical experiments performed by Fama and previous economists were based on the assumption that in an efficient market the actual stock return must coincide with what is predicted by a specific model, namely the CAPM ; the validity of such model was questioned, and a study conducted by Simon G.M. Koo and Ashley Olson from the Department of Mathematics and Computer Science of the University of San Diego(CA) was presented. Their tests , clearly evidenced that the parameter **β ,**that should account for the sensibility of the selected stock with respect to market fluctuations in return terms, didn't precisely work and most of the times, returns predicted by the CAPM were much different from actual returns. They argued the inadequacy of the CAPM in predicting stocks' returns because of the inability of taking into account other influencing variables.

Shefrin and Statman (1985), Cordell (2003) and others, tried to identify those not previously considered variables and explored the unknown applications of subject matters such as psychology ,to economic purposes . According to their investigations, inefficiencies basically arise because people and investors are not perfectly efficient entities; they're not profits or utility maximizers.

Cognitive biases or behavioral attitudes are the main sources of misjudgments or errors in evaluation that cause the rise of arbitrage opportunities and market inefficiencies. Behavioral Finance represents the antithesis of the Market Efficiency Theory. Humans' nature will never permit the perfectly efficient functioning of a financial market.

Finally, Lo, elaborated a theory that reconciled all the previous ones. He intended financial markets as evolving ecosystems where the leading principle is the “surviving of the fittest”. He borrowed a lot of concepts from biology, such as the natural selection and adaptive ones. It's a reconciling theory in the sense that it concedes the persistence of market inefficiency due to behavioral constraints but it also involves the idea of efficiency as the first goal to achieve at the end of the evolution process. The Adaptive Market Theory is teleological, in the sense that the ultimate objective is the perfect degree of efficiency. Anyways it can't be asserted if, at the end of the day, this ultimate goal will be achieved, because it is impossible to state whether the adaptation process will furnish irrational actors the means not to irrationally act anymore.

Once fully examined all the features and derivatives theories of the Market Efficiency Theory, next chapter will in dept investigate all the market inefficiencies, their nature and entity, in order to prove the validity of what concluded in this first chapter.

Chapter 2 :

Evidence against the Market Efficiency theory

Economists and scholars, who aimed at demonstrating the unreliability of the Market Efficiency Hypothesis, observed the persistence of always recurring phenomena that represented complete or partial deviations from efficiency's precepts. This chapter illustrates the most significant ones.

2.1. The January Effect

Securities markets are potentially an optimal spot to individuate and analyze irregularities or anomalies. Data related to financial markets, in fact, not only are periodically and precisely recorded, but they are also easily available. Specifically, stock markets, are supposed to be the most efficient among financial markets and factors such as transactions costs don't seem to be the explaining reason of the previously mentioned anomalies.

According to the Efficient Market Hypothesis, stock prices should follow a random walk, hence it would be impossible for a potential investor to earn considerable high returns trading just on publicly available information. Nevertheless, in the second half of the XX century, many scholars argued the predictability of stocks' behavior and the existence of seasonal patterns. Namely Rozeff and Kinney (1976) developed a trend analysis of an equal weighted index of the NYSE, from 1904 to 1974. Specifically, they found that the monthly return in January was about 3.5%, whereas other months average return was about 0.5%. More than one third of annual return was registered to occur in January. It's important to specify that, in their analysis, the index wasn't only composed by the larger and relevant companies whose shares were traded in the market. The index taken into consideration was not of the same type of the S&P500, but it was an equal weighted index, namely it was structured as a simple average of stock prices of all firms listed on the NYSE. Hence , smaller companies acquired a greater weight with respect to their actual market value and for this specific reason, the two researchers concluded that the one analyzed ,was primarily a small firm phenomenon, in the sense that the empirical evidence gathered from the sample was mainly due to the influence of small capitalization firms.

At a later stage, Keim (1983), based on his findings, concluded that the superior return, small firms were found to earn, was concentrated in time. More or less 50% of the excess returns

were registered in January and in turn 50% of the January returns were registered in the first five trading days. Finally ,Reinganum (1983) specified that January returns were considerably higher for small firms that the previous year had experienced a decrease in their stocks' price and conversely that they were not registered in the first five trading days for small firms, which stocks' price had increased the previous year. According to Reinganum, in fact, the January effect occurred due to pressures the tax-system imposed on investors. The outstanding rationale lies in the fact that investors owning shares which previously have decreased in value, usually sell them in the latter months of the year , aiming at realizing capital losses, just for tax purposes. As a consequence, stock prices inevitably continue to decrease until the end of the year. As the new year starts, the absence of selling pressures drives up again the price of the same securities.

Anyways, Reinganum's justification for the January effect attracted some criticism. In particular, Richard Roll defined such a trading strategy "*patently absurd*"(Roll,1983,p.20) and the investors who adopted it," irrational" even if all the empirical evidence, Roll found, was consistent with the January effect.

Many more researches were conducted in a lot of countries, to ascertain whether the January effect was simply a statistical peculiarity. Specifically, Gultekin and Gultekin (1983), investigated the behavior of stock prices in sixteen countries, observing exceptionally superior returns in January, in fifteen of them. Interestingly enough, in European countries such as Italy, Belgium and finally Netherland, January returns for a specific index, were higher than the average returns for the whole year.

Even if it might seem a convincing idea, linking superior January returns to tax issues, it's not the entire story. Indeed, the January effect has been observed in countries which adopt a completely different tax systems and calendars . Kato and Schallheim (1985) verified the persistence of such anomaly even in Japan, where investors are not allowed to take advantage from capital gain or capital loss offsets. Moreover, McConnell and Schlarbhaum (1984) recorded superior returns in January both in Great Britain and Australia; the astonishing point is that their fiscal year[31], doesn't coincide with the European or American one. In Great Britain it starts the first of April, while in Australia the first of July.

Thaler and De Bondt (1985) inferred that stocks that have excessively increased in value

[31] A period that a company or government uses for accounting purposes and preparing financial statements. The fiscal year may or may not be the same as a calendar year. For tax purposes, companies can choose to be calendar-year taxpayers or fiscal-year taxpayers. The default IRS system is based on the calendar year, so fiscal-year taxpayers have to make some adjustments to the deadlines for filing certain forms and making certain payments. In many instances, even fiscal year taxpayers must adhere to the calendar-year deadlines.

over a five year period are destined to offer inferior returns the subsequent period and accordingly, stocks that have surprisingly decreased in value over a five year period are destined to subsequently offer superior returns. Those superior or inferior returns were obviously for the great part recorded in January. Tinic and West (1984) analyzed the phenomenon, utilizing the CAPM as the main investigating tool and they concluded that in January, stocks' betas (β, unit of measure for the stock's sensitivity to market changing conditions) are particularly high.

Despite the consistency and the evidence of such phenomenon, Thaler (1987) concluded that private investors were not able to profitably gains from the anomaly principally due to transaction and information costs.

2.1.1. Empirical Evidence

Cumulative average excess return for years 2010,2011,2012

Figure 2.1

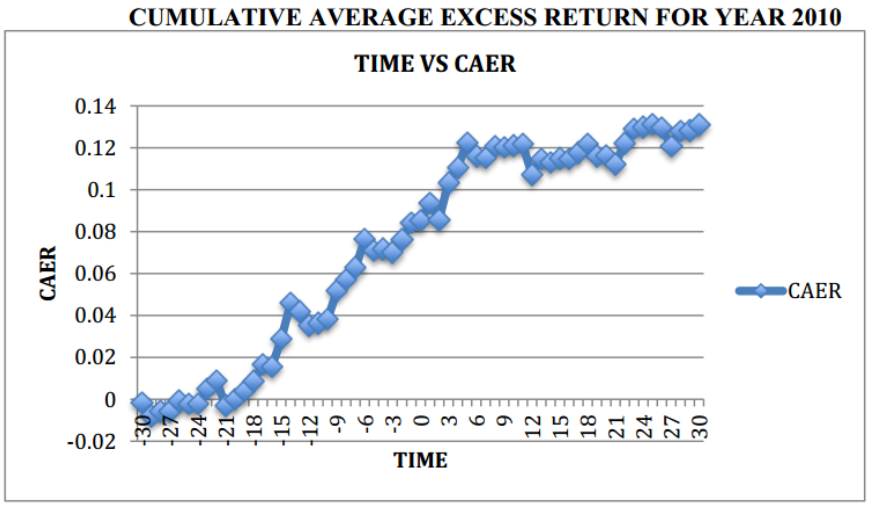


Figure 2.2

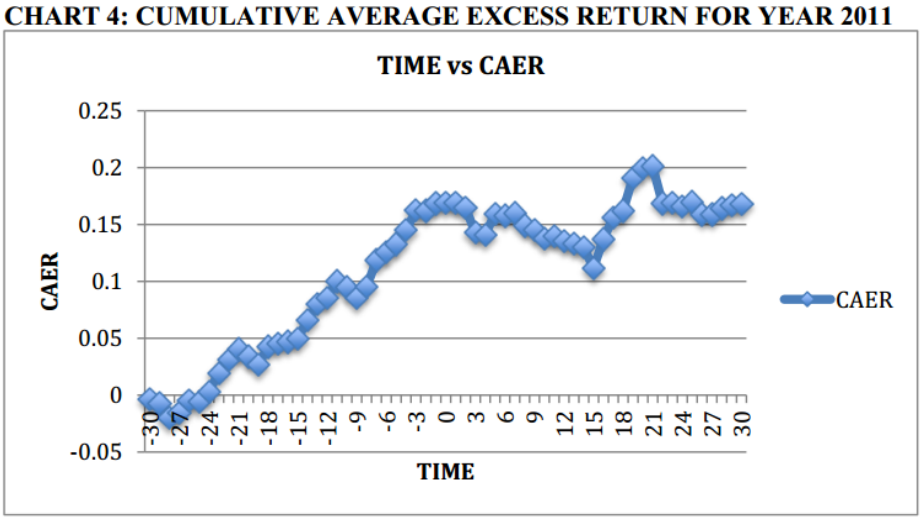
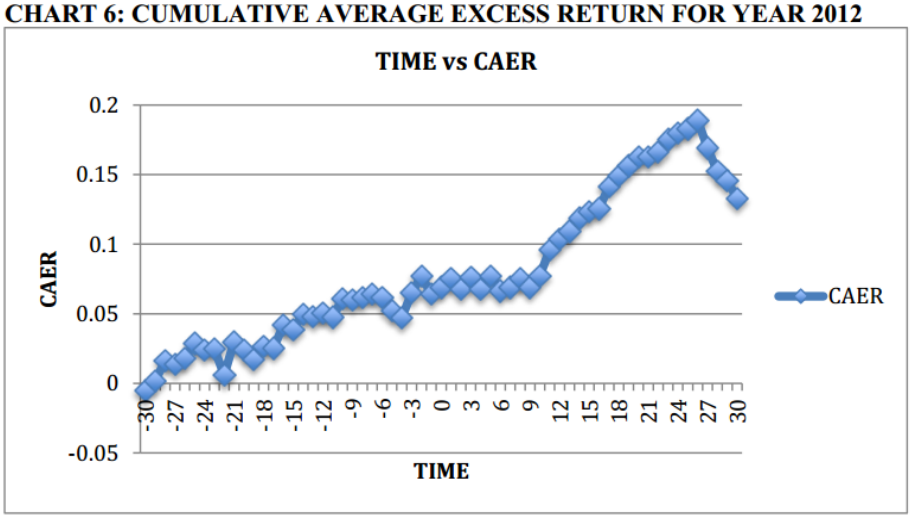


Figure 2.3

CHART 6: CUMULATIVE AVERAGE EXCESS RETURN FOR YEAR 2012



Source: Proceedings of ASBBS Volume 21 Number 1

Figures 2.1 , 2.2 and 2.3, plot the cumulative average excess returns[32] for ninety selected companies from the NYSE and the NASDAQ . Thirty of them were selected from 2010, thirty from 2011 and the remaining thirty from 2012. The analysis, performed by Frank Bacon and Shalby Klock from the Longwood University, comprehends 18'990 observations relative to ninety publicly traded securities and the S&P500 intended as a reliable market approximation. In all charts, time is plotted on the horizontal axes and the unit of measure is "days". Time 0 is considered to be the 31st of December. On the vertical axes, instead, the cumulative average excess return for each year respectively is plotted .A measure of stock's increase or decrease in price.

Data shows that stocks' prices increased starting from 21 to 30 days before the last trading day of the year. Even if the January effect is clearly visible and undisputed, markets seem, at least in their weak form, to react efficiently and this is one of the reason why investors aren't most of the times able to profit from such anomalies.

2.2. Market Overreaction

As anticipated before, most of the times, people do not rationally act and their estimations may result to be mistaken due to their inability of properly interpreting new information. Stocks prices, in certain contingencies, fluctuate more than they're expected to, simply because people overreact to new information, giving rise to market anomalies. One of the first economist who acknowledged the inappropriateness of investors' evaluations with respect to certain kind of information, was J.M.Keynes, who specifically asserted :"*day to day fluctuations in the profits of existing investments, which are obviously of an ephimeral and non significant character, tend to*

[32] the average of the sum of all abnormal returns

have an altogether, excessive, and even absurd ,influence on the market" (J.M.Keynes,1936,p.138). Whenever investigating their beliefs, investors tend to overweight new information and underweight older one. According to Kahneman and Tversky (1974), each individual, whenever dealing with a forecast, aims at predicting a certain value in such a way to let the standing of the case in the distribution of outcomes match its standing in the distributions of impressions.

Since the robustness of such anomaly suddenly appeared bright, the obvious question that scholars posed themselves was whether those who identified the anomaly were effectively able to profitably gain from it. Stated differently, if arbitrageurs, once identified and exploited the abnormality, could eliminate it. Russel and Thaler (1987), tried to provide an answer. They were convinced that as long as semi-rational investors populated financial markets, a rational expectations equilibrium would not have been guaranteed by the remaining fully rational individuals.

In addition, the Market Overreaction anomaly, seems to be connected to other interesting market pitfalls, and in principle, it can be easily linked to many more contexts. One of the possible application, according to Shiller (1990)'s findings, concerns long and short-term interest rates. He argued that the overreaction's principle, in fact, could be an explanation to the fact that when long-term interest rates are higher than short-term ones, they suddenly start to move down. Shiller also argued that the unexpected increase in volatility of a stock's price relative to a split announcement may be partially explained by investors' overreaction. This specific argument has been debated in the previous chapter.

2.2.1. Empirical tests

De Bondt and Thaler (1985), performed a really comprehensive and exhaustive empirical analysis, studying the reaction, in terms returns fluctuations, of stocks belonging to the NYSE with respect to a certain event, like an earnings announcement[33]. The analyzed time-span, covered the period from January 1926 to December 1982. The comparison term, namely the market index, was obtained thanks to an equally weighted index, composed by all CRSP[34] listed securities. All stocks were arranged in two different portfolios: the winner or the loser portfolio. The winner portfolio

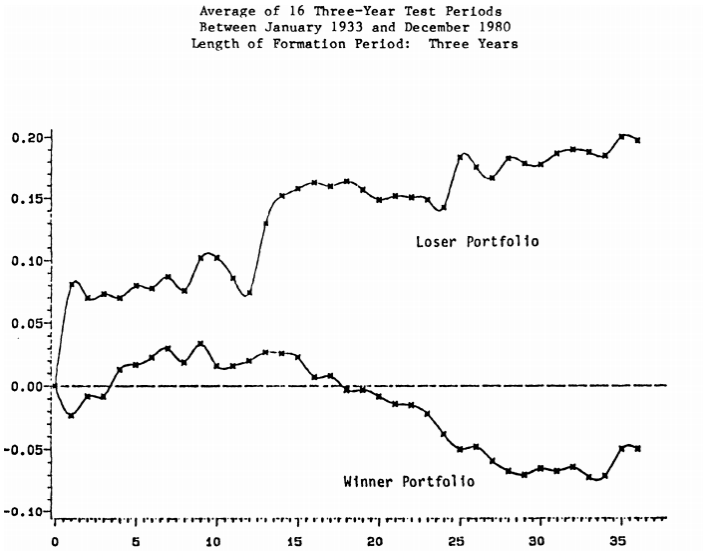
[33] An official public statement of a company's profitability for a specific time period, typically a quarter or a year. An earnings announcement is typically made on a specific date during earnings season and is preceded by earnings estimates issued by equity analysts. When the company has been profitable leading up to the announcement, their share price will usually increase after the information is released.

[34] The Center for Research in Security Prices (CRSP) is a provider of historical stock market data. The Center is a part of the Booth School of Business at the University of Chicago.

was composed by all stocks which had consistently beaten the market during the last 5 years, while the loser portfolio was composed by stocks which had always underperformed, instead, within the last 5 years prior to the survey. Results can be summarized by the following chart:

Cumulative average residuals of both the winner and loser portfolio over a 36 months period after and earnings announcement

Figure 2.4



Source: *The Journal of Finance* Vol. 40, No. 3

On the horizontal axis, the months following the earnings announcement (occurred at time 0) are reported. On the vertical axis, instead, the spread between actual returns and market returns of both portfolios is figured. Specifically ,the cumulative average residual (CAR) is defined as the sum of the differences between the expected return on a stock (systematic risk multiplied by the realized market return) and the actual return. It can be seen that the loser portfolio outperformed the market by, on average, 19.7%, thirty six months after the creation of the portfolio itself. On the other hand, the winner portfolio poorly performed under the evaluation period. The returns it earned, were 5.0% lower than the market ones. Furthermore, the difference in cumulative average residual between the two analyzed portfolios is of 24.6%, with a t-statistic[35] of 2.20, indicating that the event could be considered statistically significant. Another important implication to be inferred is that the overreaction effect is not symmetric. According to the survey conducted by Thaler and De Bondt, it is much more effective over looser portfolios than over winner ones. In addition, the overreaction effect seemed to be consistent with the January effect also. In fact, in months 1, 13, 25

[35] In statistics, the *t*-statistic is a ratio of the departure of an estimated parameter from its notional value and its standard error. It is used in hypothesis testing, for example in theStudent's *t*-test, in the augmented Dickey–Fuller test, and in bootstrapping.

corresponding to the first months of each year, the loser portfolio registered a return of respectively 8.1%, 5.6% and 4.0% in excess of the market return. Surprisingly enough, the overall excess return was registered to occur during the second and the third year of the time period into consideration.

Synthetically, the overreaction hypothesis asserts that the more we concentrate on stocks that experienced extreme returns, the more the succeeding price reversal will be marked. Thaler and De Bondt observed that the easiest way to acquire the more extreme possible observations is to extend the formation period of the particular portfolio. As an alternative, it is possible to compare the test period performance of less versus more extreme portfolios, for any assumed formation period. The two economist conduced a new survey according to these new premises and the following table summarizes the results they achieved.

Differences in cumulative average residuals returns between the winner and the loser portfolios at the end of the formation period and 1,12,13,18,24,25,36, and 60 months into the formation period

Table 2.1

Portfolio Selection Procedures: Length of the Formation Period and No. of Independent Replications	Average No. of Stocks	CAR at the End of the Formation Period		Difference in CAR (*t*-Statistics)							
				Months After Portfolio Formation							
		Winner Portfolio	Loser Portfolio	1	12	13	18	24	25	36	60
10 five-year periods	50	1.463	−1.194	0.070 (3.13)	0.156 (2.04)	0.248 (3.14)	0.256 (3.17)	0.196 (2.15)	0.228 (2.40)	0.230 (2.07)	0.319 (3.28)
16 three-year periods	35	1.375	−1.064	0.105 (3.29)	0.054 (0.77)	0.103 (1.18)	0.167 (1.51)	0.181 (1.71)	0.234 (2.19)	0.246 (2.20)	NA*
24 two-year periods[a]	35	1.130	−0.857	0.062 (2.91)	−0.006 (−0.16)	0.074 (1.53)	0.136 (2.02)	0.101 (1.41)	NA	NA	NA
25 two-year periods[b]	35	1.119	−0.866	0.089 (3.98)	0.011 (0.19)	0.092 (1.48)	0.107 (1.47)	0.115 (1.55)	NA	NA	NA
24 two-year periods[a] (deciles)	82	0.875	−0.711	0.051 (3.13)	0.006 (0.19)	0.066 (1.71)	0.105 (1.99)	0.083 (1.49)	NA	NA	NA
25 two-year periods[b] (deciles)	82	0.868	−0.714	0.068 (3.86)	0.008 (0.19)	0.071 (1.46)	0.078 (1.41)	0.072 (1.29)	NA	NA	NA
49 one-year periods	35	0.774	−0.585	0.042 (2.45)	−0.076 (−2.32)	−0.006 (−0.15)	0.007 (0.14)	−0.005 (−0.09)	NA	NA	NA

[a] The formation month for these portfolios is the month of December in all uneven years between 1933 and 1979.
[b] The formation month for these portfolios is the month of December in all even years between 1932 and 1980.
* NA, not applicable.

Source: The Journal of Finance ,Volume 42, Issue 3

Table 2.1, clearly ascertains the overreaction hypothesis. As it can be noticed, to higher values of Cumulative Average Residuals, correspond, for various groups of winner and loser portfolios, a superior effectiveness of the price reversal mechanism. Such results tend, even to isolate the overreaction effect with respect to others seasonality patterns such as the January effect or similar. Such tests, performed according to higher accuracy standards, focused on the magnitude of the overreaction phenomenon, considered on its own, without the interference of other elements.

In conclusion, experimental psychology demonstrated that people tend to overreact to unexpected events. De Bondt, Thaler and others asked themselves whether such phenomenon was influencing market's trends. They found a lot of evidence in favor of such hypothesis. They empirically demonstrated that, after an earnings announcement, loser portfolios usually outperformed winner ones, but most importantly, they consistently beat the market. Nevertheless, they also found evidence of the interrelation between the overreaction effect and other seasonality patterns.

2.3. Excess Volatility

Strongly connected to the Market Overreaction anomaly, the Excess Volatility puzzle is one of the main issues concerning the efficiency of financial markets. Experimental evidence has shown that stocks prices tend to fluctuate too much with respect to earnings or dividends announcement. Similarly, even if no announcements are published, stocks prices seem to undergo disproportional changes with respect to variations in other factors such as the discount or the interest rate. Stephen LeRoy (2005), widely debated the issue, analyzing one of the clearest examples of securities prices Excess Volatility. In October 1987,in fact, stock prices went down all around the world ,even if no new information on stocks fundamental shocked financial markets. In US, the overall market index dropped by 22%.

Anyways any individual episode, taken on its own, can't constitute a ground for statistically significant inferences. Schiller (1981), Le Roy and Porter (1981), questioned themselves whether stock prices volatility, systematically exceeded the one justified by stock and market fundamentals. They concluded that price and returns volatility should be bounded by present value relations[36], and that in the market instead, Excess Volatility was persistent . Schiller, once assumed the equivalence between stock prices and the sum of discounted values of expected dividends, argued the stock prices volatility should be at least in principle limited by what he called "the *ex-post rational stock price*" (Schiller,1981, p.425) ,defined as the sum of the actual dividends discounted at a certain rate. Schiller defined the following relation:

$$\mathbf{P^*_t = \beta\,(p^*_{t+1} + D_{t+1})} \quad ,$$

where $\mathbf{p^*_t}$ stands for the ex-post rational price and $\boldsymbol{\beta}$ is a simple discount factor[37]. "**Dt +1",** instead,

[36] All norms and standards defining the time value of money.
[37] In a discrete time model where agents discount the future by a factor of β, one usually lets β =1/(1+r) where r is

represents the dividend received in time t+1.

Schiller, plotted a lot of graphs, reporting both $\mathbf{p^*}_t$ and $\mathbf{p}_t$ over time, in order to compare expectations with actual results. The graphs showing $\mathbf{p^*}_t$ were much smoother than the ones showing $\mathbf{p}_t$. The main conclusion he gathered, was that actual volatility was excessive with respect to what efficiency markets would have predicted. Nevertheless, the method adopted by Schiller wasn't scientific at all. He was not able to effectively prove the statistical significance of the phenomenon.

On the other hand, Le Roy and Porter (1981) overcame the shortcomings of the Schiller's system, elaborating a more complete and analytical model to demonstrate the Market Excess Volatility. They argued that stock prices, dividends and any other variable necessary for the identification of future dividends were generated by a linear vector auto-regression[38]. In addition, they verified that a specific function for the variance of both stock price and payoffs can be obtained from the parameter that identifies the bivariate auto-regression for dividends and price. Price and dividend volatilities, enter the function simply because, if all auxiliary variables were good approximations of future dividends innovations, at this point, price volatility will be large while payoff volatility will be restrained. On the ground of such inferences, Porter and Le Roy constructed a joint hypothesis test for price and payoff volatility from a bivariate model of dividends and prices. Once performed this test, the two economists reported a confidence interval built on the asymptotic distribution[39] of the coefficients of the bivariate process for dividends and prices. They finally registered excess volatility but at a significance level that was not really satisfying. A lot of succeeding scholars criticized the too complex econometric system thanks to which Le Roy and Porter attempted to demonstrate the excess volatility anomaly in financial markets. For most scholars, the results they gathered were not valid and difficult to interpret.

The main weakness of the Porter-Le Roy system was the assumption of the linear process for dividends and prices that implies their stationary levels. Le Roy and Porter were aware of the above mentioned critical issue and tried to solve it including some kind of trend correction aimed at

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the discount rate.

[38] Vector autoregression (VAR) is an econometric model used to capture the linear interdependencies among multiple time series. VAR models generalize the univariate*autoregression* (AR) models by allowing for more than one evolving variable. All variables in a VAR are treated symmetrically in a structural sense (although the estimated quantitative response coefficients will not in general be the same); each variable has an equation explaining its evolution based on its own lags and the lags of the other model variables. VAR modeling does not require as much knowledge about the forces influencing a variable as do structural models with simultaneous equations: The only prior knowledge required is a list of variables which can be hypothesized to affect each other intertemporally.

[39] In mathematics and statistics, an asymptotic distribution is a distribution that is in a sense the "limiting" distribution of a sequence of distributions. One of the main uses of the idea of an asymptotic distribution is in providing approximations to the cumulative distribution functions of statistical estimators.

removing the upward influence for both variables. Unfortunately, trend correction mechanisms usually tend to modify and distort the time-series properties of the considered variables and, in fact, it seemed that the difficulty of demonstrating the statistical significance of stock prices Excess Volatility, encountered by the two economists, was mainly due to these kinds of correction mechanisms.

In any case, these types of issues were partially solved around 1990. The economic community was starting to realize that in order to be fairly tested, such hypothesis required an assumption of risk neutrality. As argued by Le Roy (1981), in principle, stock prices equal the discounted value of future dividends, if and only if, future dividends are always discounted at the same rate, that is, if each economic actor values the risk in the same way or he is simply risk neutral. Nevertheless, Behavioral Finance teaches that some individuals are risk lovers and some other are risk averse. In evaluating stock prices, they discount future expected dividends at a different rates. However, at that time, the majority of the renowned economic authorities didn't fully understand the necessity of risk-neutrality. Samuelson (1965), for instance, in his paper regarding the relationship between Martingale models and the present-value relations, skirted the issue. Furthermore, Fama (1970) himself, on his dissertation on Market Efficiency (debated in Chapter 1) , argued that capital markets efficiency could only be tested along with a specified evaluation model ,necessary for computing returns. In spite of such inference, Fama wasn't able to notice that the return model standing at the base of the prevailing market efficiency tests didn't take into account risk aversion.

At the beginning, the essential relationship between variance-bound tests and risk neutrality, seemed not to be that essential but very soon scholars such as LaCivita along with LeRoy (1965), presented undeniable arguments. They used a two state's version of Lucas (1978)' tree model[40] to demonstrate that the presence of a risk aversion discounting model may increase the predicted volatility of stock prices.

Risk adverse investors, in fact, aim at smoothing their consumption across time, switching it from low-marginal utility assets to high marginal utility ones. In any case, in an exchange economy, investors are not allowed to do so in the aggregate. The economic actor, in fact, must consume the

[40] Lucas studied a pure exchange economy with a representative consumer (or household), where *pure exchange* means that all endowments are exogenous ,*representative* consumer means that either there is a single consumer (sometimes also referred to as a household), or all consumers have identical endowments and preferences. Either way, the assumption of a representative agent means that prices adjust to eradicate desires to trade. This makes it very easy to compute competitive equilibrium prices

aggregate provision in equilibrium, in such a way that prices neutralize preferences. Assuming that stock prices are very high when the marginal utility of consumption is low and that the other way around occurs when the marginal utility of consumption is high, investors should acquire financial assets when they're costly and sell them when they're low priced if their intention is to transfer claims on consumption; but if price volatility is extremely high investors prefer to consume the provision.

Successively, Mehra and Prescott (1985) wrote a paper based on the one written by LaCivita and Le Roy and on the Lucas' tree model to two states, modifying it in the sense that according to his paper, the states described the growth rate of the provision rather than its absolute level. The new model provided by both Mehra and Prescott assumed the investor to have a homothetic utility function and with power utility. Furthermore when consumption growth rates are stable over time, no trend corrections are needed. Both Mehra and Prescott constructed a simpler and more effective model. Within it, no distinction was made between corporate earnings, dividends and aggregate consumption even if those variables perform in different ways.

Specifically, Le Roy and Parker noticed that such model could be suitable to Excess Volatility evaluation, once independently distributed consumption growth rates are assumed. The volatility of a specific variable, in fact ,depends on the degree of completeness of information the agent owns about future consumption beyond the information contained in present consumption. Whenever investors do not owns such typology of information, price constantly represents a markup of consumption and consequently stock prices reflect the same volatility of the consumption growth rate. Nevertheless such prediction is rejected by data regarding US. The standard deviation of the consumption growth in fact appears to be about 2% according to Le Roy, while that of annual stock returns reaches 20%.

Furthermore, Le Roy asserted that even if one have to assume that consumption follows a geometric random walk, he can't subsequently assert that investors have no information variables for future consumption planning. If investors possessed such information, stock prices would never be a markup of consumption. Parker (2001), along with Le Roy, demonstrated that in that specific case the variances of the price-consumption ratio and the return on stock ,follow a relationship similar to the one described by Le Roy-Porter(1981). The resulting joint hypothesis test[41] on the volatility of the price consumption ratio and the volatility of stock prices showed that these variables move accordingly. Excess volatility was recognized in either variables or both.

[41] A statistical hypothesis is a scientific hypothesis that is testable on the basis of observing a process that is modeled via a set of random variables.[1] A statistical joint hypothesis test is a method of statistical inference used for testing a double statistical hypothesis.

Most of the analysts aren't nowadays convinced of the theory aimed at explaining such market anomaly. They're unanimous only on the fact that prices of financial securities fluctuate more than their fundamentals are allowed to justify.

2.4. Mean Reversion

The Mean Reversion Effect is defined as the phenomenon according to which, in the long-run, stocks prices (and returns) eventually move back towards their mean or average. The mean or average can be considered the historical one or another relevant measure such as the growth in the economy or the average return of an industry. The Mean Reversion anomaly has always been considered a persistent phenomenon in financial markets and a consistent ground for profitable trading strategies in the last ninety years. A trading strategy constructed on such a market pitfall, aims at gaining from the extreme range of values that stocks prices may acquire over long term averages and furthermore it can be performed at a double level : at the absolute and at the relative one. A mean reversion investing strategy, performed at the absolute level, only focuses on the direct relationship between stock prices and their long-term averages while a mean reversion investing strategy, performed at the relative level, takes into consideration the performance of a specific stock with respect to the market it belongs to.

Not surprisingly, the existence and the persistence of such a market inefficiency is mainly attributable to the irrationality of financial investors . In particular, Kanhema and Tversky (1974) defined it as the product of three well defined erroneous behaviors, people continuously adopt. Such behaviors can be indentified respectively in:

- the availability bias ,
- the aversion to losses and
- the affinity for lower prices.

The availability bias consists in the human attitude to rely ,mostly on information that is easily recallable from memory ,even if it couldn’t be the most relevant or suitable one.

Kanhema and Tversky moreover described why stocks tend to mean revert and traced the causes in the investors' inability to equally weight relevant information despite their collocation in time. When investors acquire bad news, they usually become *loss averse*, unwilling to sell their stocks not to recognize losses, even if stock prices are destined to drop further. Once the specific

information has been digested by all economic actors, a previously undervalued[42] stock starts its recovery, outperforming the market and inverting its previous trend.

The last factor that seems to cause the Mean Reversion Effect is the *attractiveness of low prices.* Behavioral Finance, describes the satisfaction of purchasers whenever buying products at a lower prices or at discounts. According to De Bondt and Thaler (1987), the same applies in capital markets.

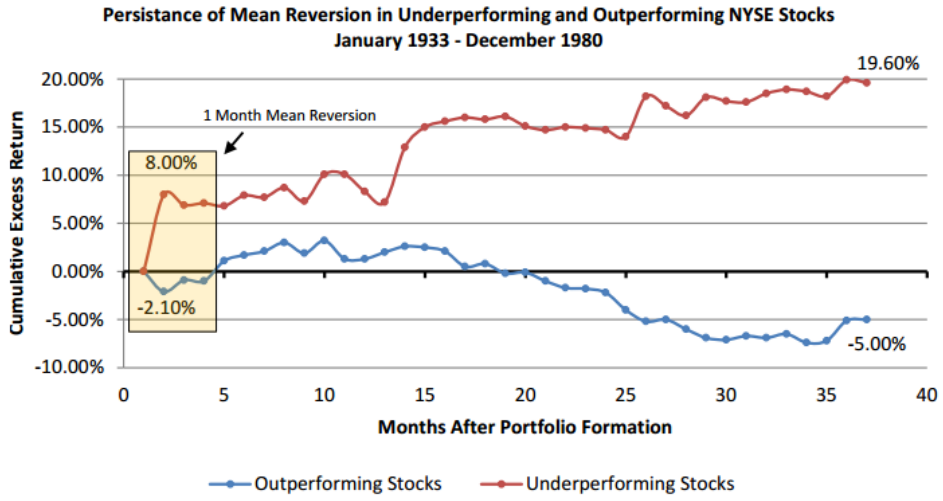
All these psychological biases clearly exacerbate the attractiveness of underperforming stocks along with the willingness to sell outperforming ones.

2.4.1. Empirical evidence of Short Run Mean Reversion

The great majority of authors studied the mean reversion phenomenon under a long run perspective. Indeed, De Bondt and Thaler (1987) focused their attention on the evidence of such anomaly in a shorter time period, specifically one month. They conducted their survey investigating the behavior of stocks prices of securities traded in the NYSE from January 1933 to December 1980. De Bondt and Thaler's findings may be summarized by the following graph :

The Mean Reversion Effect persistence in the NYSE over the period January 1933-December 1980

Figure 2.5



Source: The Journal of Finance Volume 42, Issue 3

[42] A financial security or other type of investment that is selling for a price presumed to be below the investment's true intrinsic value. A undervalued stock can be evaluated by looking at the underlying company's financial statements and analyzing its fundamentals, such as cash flow, return on assets, profit retention and capital management, to determine said stock's intrinsic value.

Figure 2.5 shows the trend of both stocks that in previous periods, outperformed the market (the blue line) and underperformed it (the red line) ,over thirty-six months. At the end of the time span under consideration, the previously underperforming stocks evidenced a Cumulative Excess Return of 19.60% with respect to market normal returns, while the previously outperforming stocks earned a return of 5% below the market one. Interestingly enough, the 41.06% of the registered outperformance occurred in the first month. In fact in the first month, stocks which had previously underperformed, collected a return of 8%, whereas stocks which had previously outperformed, underperformed the market by 2.10%. Moreover, the one month holding period registered the highest statistical significance level than any other else. As suggested by Jagadeesh (1990), in fact, monthly returns on individual stocks exhibited significantly negative fist-order serial correlation.
According to the analysis provided above, short term mean reversion could constitute a feasible ground for profitable investment strategies. Anyways, in the past, transaction and information costs, implementation barriers and high portfolios turnover[43] didn't allow investors to earn considerably high returns. Starting from the 1990s, the evolution of the investment sector from brick and mortar[44] to electronic centric, demolished most of the above mentioned barriers to profits. Today, short trading strategies are much simpler to implement and much less costly.

2.4.2. Empirical Evidence of Long Run Mean Reversion

Poterba and Summers (1988), two American economists, concentrated their analysis on the long-run behavior of stock prices. The analytic tool, thanks to which they investigated the mean reversion phenomenon, was the variances ratio. They principally asserted that long-run volatilities should be the same whether or not stocks prices are mean reverting. Anyways, according to their analysis, short-run volatilities should, instead, be greater if prices are mean reverting. Consequently the ratio of long-run volatilities to short run ones should be smaller in the case of mean reverting stocks prices. Poterba and Summers indirectly investigated the Mean Reversion anomaly , collecting data and computing variances ratios. They argued that, assuming efficient markets, the volatility of a hypothetical investment promising at best an annual return of 20% and at worst an annual return of -10%, is 30% (20%-(-10%)). On the other hand, if the investment was protracted to two years, the best possible return becomes 40%, while the worst one -20%. In this case the

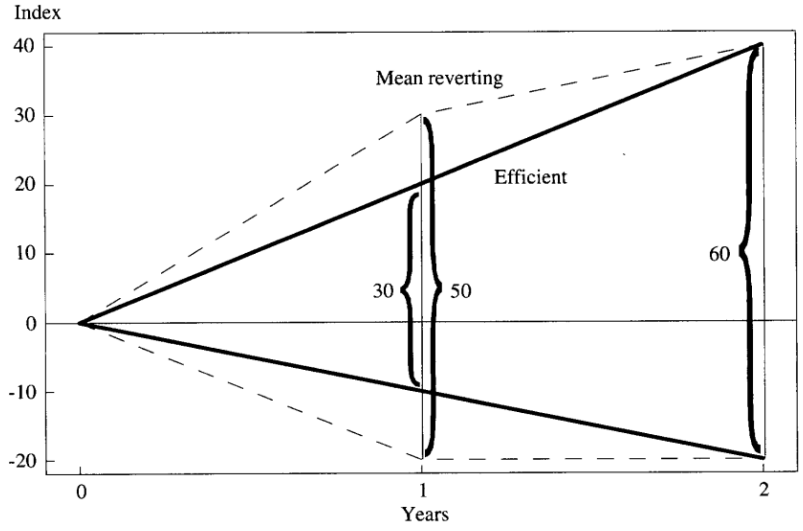
[43] one of the more easily explained investment qualities. Expressed as a percentage, it tells us what portion of the securities (stocks, bonds, or both) in a fund's portfolio are bought and sold during the course of a year.
[44] A traditional "street-side" business that deals with its customers face to face in an office or store that the business owns or rents. The local grocery store and the corner bank are examples of "brick and mortar" companies. Brick and mortar businesses can find it difficult to compete with web-based businesses because the latter usually have lower operating costs and greater flexibility.

investment volatility turns out to be exactly twice the one-year volatility: 60%. Analytically, they debated that the volatility of a "k" years investment , in efficient capital markets, is exactly "k" times the volatility of the same one year investment. Nevertheless if prices are mean reverting, the volatility of a "k" years investment would be much lower than k times the volatility of the same one year investment. This occurs because prices overshoot fundamental value only in the short-run, period in which they reflect excess volatility.

Recalling the previous example, indeed, assuming that due to market inefficiencies the same investment didn't perfectly reflect its fundamentals and its one year best return was fixed at 30% while the worst at -20% , its volatility would be 50%. If the following year, the price had returned to its fundamentals, the maximum two-year return would become 40% again, while the minimum would be -20% and thus the two-years volatility is the same as before, namely 60%. It can be deduced that, in this situation, the volatility of the two-years investment is much less than twice the volatility of the one-year investment as the following graph precisely describes:

Differences in volatilities between a mean reverting and an efficient stock

Figure 2.6



Source: Journal of Financial Economics ,Volume 22

The marked black line, shows the returns the specific investment would earn at its best and worst, in both holding periods (one year or two), and in a perfectly efficient capital market. The dotted line, instead, merely shows the same thing with the exception that values for returns, referring to the first year, are exacerbated due to market inefficiencies.

Poterba and Summers, argued that the mean reversion hypothesis could be tested by

analyzing whether stocks volatilities grow proportionally over time. As asserted before, in an efficient market the following equality must hold:

variance(rk)= k variance (r1) or *Variance(rk)/k variance(r1)=1,*

Where "r" stands for the return of a specific investment and "k" represents its time horizon.

Hence, if markets were efficient, the ratio of the variances for all investment horizons should equal 1. Whenever, instead, the ratio of the variances is lower than 1, it means not only that the market isn't efficient but also that stocks prices are mean reverting. The survey the two economists conducted was comprehensive of the variances ratio for investment horizons from two to eight years. The dataset was composed by excess returns on the NYSE for the time period between 1926 and 1985, computed as the difference between the NYSE monthly returns and the Treasury Bill[45] ones. Once all data were collected and analyzed, Poterba and Summers concluded that for investment horizons greater than two years, every variances ratio was less than one, meaning that the market wasn't efficient at all and that the Mean Reversion anomaly was undeniable, even under a statistical viewpoint. They found, for instance, that eight years returns were only 3.5 times more volatile than the one year returns. In addition, they discovered that the Mean Reversion phenomenon was much more clear for small firms relative to bigger ones.

An alternative way to test whether stocks prices are mean reverting, is regressing actual stocks returns on past returns. If the market is efficient, returns should remain constant in the long run and thus must be unrelated to past ones. On the other hand, if the selected market reflects some degrees of inefficiency, periodic returns must be correlated between themselves. Specifically, assuming perfect capital markets, in a regression of stocks returns on a constant term and past returns, the constant term may be positive while the slope coefficient on past returns has to be zero. If ,instead, prices initially tend to increase faster than the market trend but then slow down as soon as they return to it, that is prices are mean reverting; returns will be above and below normal, and in a regression line, the slope coefficient will be negative.

Fama & French in 1998 published a survey on mean reverting stocks prices. They collected monthly data adjusted for inflation from the NYSE over the period 1926-1985. Aiming at testing for Mean Reversion, they decided to regress multi-years returns on past multi-years returns ,for investments which time horizons were extended from one to ten years. Their findings too, supported the existence of the Mean Reversion phenomenon. According to their data, indeed, coefficients on past returns became negative for two years returns, then reached a minimum for three to five years

[45]A short-term debt obligation backed by the U.S. government with a maturity of less than one year.

returns and finally approached zero when the investment horizon increased to eight years. Finally, Fama & French, concluded that the Mean Reversion Effect appeared stronger over small firms as previously suggested by Poterba and Summers (1988).

2.5. The Neglected Firm Effect

The Neglected Firm Effect, suggests that securities often ignored by analysts usually offer strictly higher returns than well known securities. The difference between the neglected security returns and the market returns is commonly named *"neglected premium".* The main rationale behind the Neglected Firm Effect, concerns the higher risk involved in securities issued by neglected companies and the consequent higher return they offer, as the Capital Asset Pricing Model predicts. The greater risk may arise from both less institutional monitoring and from the higher probability according to which managers and insiders of small neglected firms may exploit shareholders. Furthermore, the complete absence of analysis or judgments regarding the firm's performance, increases the uncertainty in its securities' price evaluation.

One of the most comprehensive and exhaustive research ,regarding such market pitfall ,was conducted by Carvell (1987), associate Professor of the Cornell University in New York. His main intent, was to deeply analyze the statistical significance of the Neglected Firm phenomenon and first of all to check whether it represented a separate and distinct effect or if it was ,along with other market pitfalls, in reality the expression of an overall unique anomaly. He was strongly convinced that securities neglected by analysts, or listed for a shorter period of time, indeed sell at a discount due to the relative lack of information about their future return distributions. On the other hand, when projecting future return distributions ,intensive analysts' coverage and long listing periods, enlarge the information availability to investors, in such a way to raise stock prices and lower returns for highly followed firms. Anyways if, in reality, it is the case, there should be more than one fundamental reason explaining the abnormal returns of neglected firms and furthermore, the Neglected Firm Effect should be empirically distinct from other correlated anomalies such as the previously argued January or Small Firm Effect (a theory holding that smaller firms' stocks, or stocks of those companies with a small market capitalization, outperform larger companies' ones; one of the main market anomalies that will be briefly introduced in this paragraph to be widely debated in the whole last chapter).

Carvell (1987), obtained all data he needed to construct his survey by two relevant sources .

The research coverage by analysts was obtained from the IBES(Institutional Broker Estimate Survey), a fully comprehensive database developed by "Lynch, Jones and Ryan", a New York brokerage firm. The database contained values for seventy-nine months , over the period from January 1976 to July 1982 and specifically for more than 2000 companies each year . The basic information contained into the database, basically consisted of predictions of future earnings, mean forecasts and their standard deviation for each of the selected companies. The second source of data, Carvell exploited to implement his study ,was the CRSP (Center for Research in Security Prices) database. He took under consideration only monthly return files. Once traced all the correspondences between the two data sources, Carvell ended up with both financial analysis and monthly return data for 865 stocks. A robust sample. The time period under consideration was limited to the seventy-two months common to both databases. The study, in fact, covered from January 1976 to December 1981. In addition, Carvell individuated in the ninety-day Treasury bill monthly return, the risk-free rate and as a last step approximated the market thanks to a value weighted index[46] , namely the Wilshire 500[47], in order to leave intact as much of the Small Firm Effect as possible and permit a careful analysis of the interaction between this other anomaly and the Neglected Firm Effect. Successively, the stocks' sample was separated into three equally sized portfolios, based on the number of analysts' ,reporting EPS estimates for each stock. The portfolios were, in addition, recomposed each month to ensure that each one contained only securities with the appropriate level of analysts' coverage. Furthermore, the average monthly returns and excess-risk-adjusted returns[48] were computed for each portfolio all over the time period under analysis.

To control for size, all these procedures were repeated for three categories of market value, which produced nine iso-neglect and iso-size portfolios for comparative analysis. To avoid the interference of the January Effect over the Neglected Firm anomaly, the tests were repeated once January returns were eliminated from the sample.

The table below shows the obtained results:

[46] A type of market index whose individual components are weighted according to their market capitalization, so that larger components carry a larger percentage weighting. The value of a capitalization-weighted index can be computed by adding up the collective market capitalizations of its members and dividing it by the number of securities in the index.

[47] A market capitalization-weighted index composed of more than 6,700 publicly-traded companies that meet the following criteria: 1. The companies are headquartered in the United States. 2. The stocks are actively traded on an American stock exchange. 3. The stocks have pricing information that is widely available to the public

[48] A concept that refines an investment's return by measuring how much risk is involved in producing that return, which is generally expressed as a number or rating. Risk-adjusted returns are applied to individual securities and investment funds and portfolios.

Average monthly returns by neglect categories 1976-1981

Table 2.2

RCR1	Ret*	= 0.011
>8 Analysts	Avg. No. of Analysts	= 14.6
	Avg. Mkt. Value	= $1,955.6**
	Avg. Beta	= 1.09
	Ret	= 0.017
RCR2	Avg. No. of Analysts	= 5.1
3–8 Analysts	Avg. Mkt. Value	= $366.2
	Avg. Beta	= 1.18
	Ret	= 0.024
	Avg. No. of Analysts	= 0.85
RCR3	Avg. Mkt. Value	= $123.3
<3 Analysts	Avg. Beta	= 1.22

* Average monthly return including dividends
** in millions

Source: Cornell University. School of Hotel Administration. The Scholarly Commons ,Articles and Chapters(1987)

The first category reported in table 2.2, "Research Concentration Ranking 1(RCR1)", indicates all securities with at least eight analysts covering them. The average monthly return for this kind of stocks was found to be 0,011 with respect to the 0.024 of the portfolio composed by neglected stocks, represented instead by the third category in table 2.2, namely Research Concentration Ranking 3 (RCR3), which is composed, instead, by securities with less than 3 analysts covering them (neglected stocks). The intermediate category, RCR2, seemed to confirm the Neglected Firm Effect. The portfolio composed by securities which had been analyzed by a number of analysts between 3 and 8, reflected a return higher than the first category portfolio (RCR1) but strictly lower than the third one (RCR3). A portfolio composed by moderately analyzed stocks, according to Carvell's analysis, showed a performance in between a portfolio composed by accurately analyzed stocks and a portfolio composed by neglected stocks. Moreover, table 2.2 shows how the market value of the three selected portfolios decreased as long as the number of analysts analyzing them increased while the portfolios ' average beta decreased.

According to such evidences, Carvell decided to analyze them through the regression model. He regressed the following function:

Number of analysts regressed over beta and LogSize

$$NA_i = \gamma_1 \beta_i + \gamma_2 (\text{Log Size}_i)$$

Table 2.3

$R^2 = 0.6013$ *Variable*	*Coef.*	*Std. Error*	*t-value*
Beta	– 2.53	0.074	34.19
L Size	1.10	0.023	47.83

Source: Cornell University. School of Hotel Administration. The Scholarly Commons ,Articles and Chapters(1987)

NA, stands for the number of analysts, beta, as usual, represents the sensitiveness of the portfolio to market variations and Log Size is the logarithm of the size of the firms belonging to the portfolio. Carvell exploited the logarithm function simply because it smoothes and normalizes data, minimizing errors' issues. As the parameter R^2 [49] suggests, more than sixty percent of the variation in the number of analysts, is justified by fluctuations in beta and in the firm size. According to the data he gathered, variations in beta were negatively correlated to fluctuations in the number of analysts, while fluctuations in the firm size were positively correlated. Carvell tempted to correct the previous results for firm size influences and presented the following table:

Table 2.4

Returns controlled for Beta and Size

	SZGR3 (small)	*SZGR2 (medium)*	*SZGR1 (large)*	*MEAN RCR*
RCR1 (closely followed)	RET = -0.016 ER = -0.025**	RET = 0.011** ER = -0.002**	RET = 0.011** ER = -0.0009	RET = 0.011** ER = -0.0015*
RCR2 (moderately followed)	RET = 0.011** ER = -0.004**	RET = 0.018** ER = 0.04**	RET = 0.017** ER = 0.005**	RET = 0.017** ER = 0.003**
RCR3 (neglected)	RET = 0.024** ER = 0.011**	RET = 0.023** ER = 0.012**	RET = 0.024** ER = 0.013**	RET = 0.024** ER = 0.011**
MEAN SIZE	RET = 0.022** ER = 0.008**	RET = 0.018** ER = 0.005**	RET = 0.013** ER = 0.001*	

* Significant at the 90 percent level
** Significant at the 95 percent level

Source: Cornell University. School of Hotel Administration. The Scholarly Commons ,Articles and Chapters(1987)

Firms were separated according to their capitalization values[50], ranking from the smallest (less than 100$ millions) to the largest ones (more than 500$ millions). “RET” stands for the average monthly returns from the equally weighted portfolios while “ER” represents the excess returns ,once adjustments for systematic risk were made.

The main inference Carvell obtained was that both the Neglected Firm and the Size Effect

[49] In statistics, the coefficient of determination, denoted R^2 or r^2 and pronounced R squared, is a number that indicates how well data fit a statistical model – sometimes simply a line or curve

[50] The total dollar market value of all of a company's outstanding shares. Market capitalization is calculated by multiplying a company's shares outstanding by the current market price of one share. The investment community uses this figure to determine a company's size, as opposed to sales or total asset figures.Frequently referred to as "market cap."

,survived every risk adjustment. The difference in excess returns between neglected stocks portfolios (RCR1) and the covered ones (RCR3) went from -0, 0015 to 0,011 per month ,on average. On the other hand, the average monthly returns for a portfolio composed by equities of small-sized firms (SZGR3) were at 0,008, while for a portfolio composed by equities of large-sized firms were only at 0,001. Carvell concluded that the Size and the Neglected Firm effect were negatively correlated, as it can be noticed by the similarity of excess returns on the mean RCR and on the mean SZGR.

In addition, moving down through the columns, in table 2.4, excess returns appear to be always higher, without exceptions. Hence, even if the two effects are correlated, a considerable evidence of the influence on portfolios returns of the Neglected Firm Effect, survived the correction for firms' size. The Size Effect, was evident, but insignificant after checking for neglect.

However, Carvell was also interested in verifying whether the Neglected Firm Effect was in some way correlated to one of the most influential seasonal anomaly: the January Effect. For this specific reason he performed the same analysis, exceptionally eliminating all January returns from the sample. Results are offered by table 2.5.

Table 2.5

Returns controlled for Beta, Size and January Effect

	SZGR3 (small)	*SZGR2 (medium)*	*SZGR1 (large)*	*MEAN RCR*
RCR1 (closely followed)	Ret = −0.018 ER = −0.023*	Ret = 0.010 ER = −0.033**	Ret = 0.011** ER = 0.0009	Ret = 0.01** ER = −0.0016**
RCR2 (moderately followed)	Ret = 0.006** ER = 0.007**	Ret = 0.016** ER = 0.003**	Ret = 0.017** ER = 0.005**	Ret = 0.014** ER = 0.001**
RCR3 (neglected)	Ret = 0.018** ER = 0.005**	Ret = 0.02** ER = 0.009*	Ret = 0.021** ER = 0.01*	Ret = 0.019** ER = 0.007**
Mean SZGR	Ret = 0.016** ER = 0.003**	Ret = 0.016** ER = 0.004**	Ret = 0.013** ER = 0.0009	

* Significant at the 90 percent level
** Significant at the 95 percent level

Source: Cornell University. School of Hotel Administration. The Scholarly Commons ,Articles and Chapters(1987)

The first evidence is that the correction for the January Effect weakened pretty much the prominence of the Size Effect, in terms of registered returns. Indeed, average returns of portfolios composed by securities issued by small firms were 0.016, while for portfolios composed by securities issued by large companies, returns were slightly lower, namely 0.013. In addition, excess returns that according to the Size Effect should increase as well as the firm size diminishes , were registered to decrease whenever passing from medium sized firms to small sized ones, namely from

0.004 to 0.003. These results were consistent with the study performed by the previously cited Reinganum (1981), Roll (1981) and Keim (1982). Generally, about 50% of excess returns of small capitalization stocks were registered in January.

Nevertheless, Carvell was interested in analyzing whether the Neglected Firm Effect persisted despite the correction for both the January and the Size Effect. Table 2.5 clarifies how the intensity of the Neglected Firm Effect had been diminished even if there was strong evidence that the phenomenon was statistical significant anyway. Average and excess returns still appeared negatively correlated to the degree of neglect. Such relationship was made clear by Carvell who represented the results figured in table 2.5, in a regression form, showed below (table 2.6) :

Table 2.6

Pooled cross sectional regression

$$R_p = \delta_0 + \delta_1 (MBeta) + \delta_2 (MNA) + \delta_3 (LMSIZE)$$

Variable	*N**	*Mean Coefficient*	*Standard Error*
Intercept	66	0.0097	0.0133
MBeta	66	0.004	0.0046
MNA	66	−0.0006	0.0002
LMSIZE	66	0.0003	0.001

* There are 66 months of Data in this cross-sectional analysis. 72 months in the sample less six months of January data which are eliminated prior to the computation of the pooled coefficients.

Source: Cornell University. School of Hotel Administration. The Scholarly Commons ,Articles and Chapters(1987)

Actual returns were regressed on different variables, such as the parameter beta (Mbeta), the number of analysts (MNA) and the firms size (LMSIZE). After eliminating January returns, the coefficient of the variable LMSIZE appeared strictly positive but not statistically significant, in fact the standard error is more than three times bigger than the coefficient value. Hence, size anomalies seemed not to be relevant whenever accounting for the January Effect. The coefficient of MNA, instead, appeared negative and statistically significant. It seemed indicative of the inverse relationship between the number of analysts covering a specific stock and the return earned by that stock. Results of such regression were consistent with the results provided in table 2.5, since the inverse relationship between returns and number of analysts had been confirmed by the regression analysis even when correction for seasonal anomalies were added to the model.

In conclusion, Carvell asserted that at the light of the fact that the Neglected Firm Effect survived both the corrections for the January and the Small Firm Effect, it had to be considered an effective ,independent and statistically significant phenomenon.

Chapter 3:

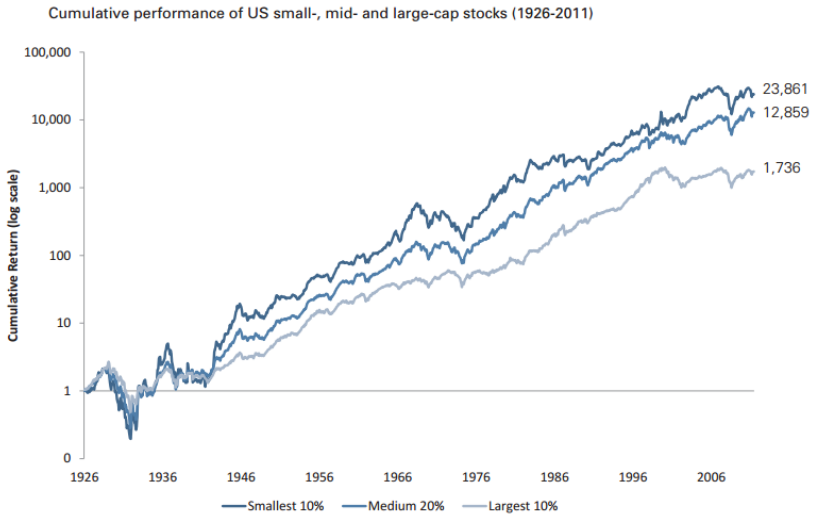
The Small Firm Effect in detail : empirical evidence and possible causes

3.1. The Small Firm Effect

The Small Firm Effect (SFE), represents one of the most important challenge to the Capital Asset Pricing Model elaborated by Sharpe, Lintner, Black and others. It consists in the experiential evidence ,a lot of economists collected over time, that small capitalization stocks[51] tend to outperform large capitalization[52] ones, in the long run. In addition, such returns' differential, couldn't be completely attributed to variation in stocks' riskiness since, at least theoretically, the CAPM does consider risk components whenever adopted in stocks' returns evaluation.

Cumulative performance of US small, mid and large cap stocks over the period 1926-2011

Figure 3.1



Source: Kenneth French Data Library; NBIM calculations

Figure 3.1 shows the cumulative performance of US small, mid and large capitalization stocks from 1926 to 2011. The dark blue line, plots the Cumulative Returns in log term over time, of a portfolio composed by the 10% of the US smallest capitalization stocks. The pale blue line instead, depicts the trend of cumulative returns in log term over time of a portfolio composed by the middle 20% capitalization stocks. Finally the light blue line is figurative of the cumulative returns

[51] Refers to stocks with a relatively small market capitalization. The definition of small cap can vary among brokerages, but generally it is a company with a market capitalization of between $300 million and $2 billion.
[52] A term used by the investment community to refer to companies with a market capitalization value of more than $10 billion. Large cap is an abbreviation of the term "large market capitalization". Market capitalization is calculated by multiplying the number of a company's shares outstanding by its stock price per share.

earned over time, always in log terms, by a portfolio composed by the US largest 10% capitalization stocks. The divergence between the trends followed by each portfolio appears shiny. Indeed, one dollar invested in 1926 in the small capitalization portfolio, would have produced a return 13, 79 (23.86/1.73) times higher than a dollar invested in the large capitalization portfolio, till 2006. Returns of the mid-sized capitalization portfolio instead, lie in between : 7,42 times higher than the large capitalization stocks portfolio, but about a half (53%) of the portfolio composed by the US smallest capitalization stocks .

The first scholar who noticed and documented the SFE was Banz (1981). He conducted a detailed survey about such anomaly, analyzing the trend of the NYSE stocks from 1936 to the late 1970s. He concluded that, in the above mentioned time span, small firms outperformed bigger ones both in absolute and in market risk-adjusted terms.

The interpretations of the SFE have been drastically changed over the last thirty years. On one hand, former scholars thought the effect as a market anomaly since the higher returns earned by smaller capitalization stocks weren't justified by the Sharpe-Lintner Asset Pricing Model. The CAPM, in fact, relates stocks returns just to one risk factor (**β**), namely a parameter evaluating the sensitiveness of each security to market fluctuations. On the other hand, Fama and French wrote a lot of papers in which they argued how the SFE was not a market anomaly but instead the expression of a considerable higher systematic risk small capitalization stocks involve and that the CAPM was not able to capture. To solve the evaluating returns' issue, Fama and French (1995) suggested the introduction of a risk factor accounting for the firm size and another risk factor related to the firm's book to market ratio[53]. According to their researches, the introduction of such factors would have favored a better explanation of the variations in returns between small and large capitalization stocks. Following Fama & French's publications, a lot of economists hardly debated the phenomenon, attempting to justify it in alternative ways. Lo and MacKinlay (1990) argued that the SFE was simply the outcome of data mining[54]. Keim (1983) was convinced it was the result of influences produced by seasonal tax, Stoll and Whaley (1983) traced the SFE's causes in transaction costs while Acharya and Pedersen (2005) in relative illiquidity. Finally, behavioral economists, assert that such anomaly occurs due to investors' irrational attitudes and evaluations, in one word: cognitive biases. Nevertheless the reasons according to which the phenomenon persists over time

[53] A ratio used to find the value of a company by comparing the book value of a firm to its market value. Book value is calculated by looking at the firm's historical cost, or accounting value. Market value is determined in the stock market through its market capitalization.

[54] Data mining (the analysis step of the "Knowledge Discovery in Databases" process, or KDD), an interdisciplinary subfield of computer science, is the computational process of discovering patterns in large data sets involving methods at the intersection of artificial intelligence, machine learning, statistics, and database systems.

aren't still precisely defined and delineated.

Since the discovery of the SFE in 1981, researchers had some difficulties in analyzing the causes because of the sudden decline of the phenomenon's intensity. In the period between 1980 and 1981 there wasn't strong evidence of small capitalization stocks earning higher returns than larger ones. For this reason, a lot of scholars improperly declared the SFE prematurely deceased. However Van Dijk (2011), recently argued that the SFE experienced more than one period of underperformance but that shouldn't be sufficient to declare it dead. Small capitalization stocks' incredible renewed performance with respect to large capitalization ones, after 2000 was the tangible proof of the solidity of the effect, even in last decades.

The main purpose of this thesis is to derive the empirical evidence of the SFE ,to analyze it and evaluate whether the anomaly can still be easily traceable and exploitable by investors in financial markets. Furthermore, causes and all related issues will be deeply investigated.

3.2. Empirical Evidence

This paragraph aims at providing the empirical evidence of the existence of the Small Firm Effect, not only in US, where the phenomenon was firstly discovered and documented, but also in global markets. Economic literature, principally adopted two methods for evaluating the phenomenon's intensity. The first consists in the construction of cross sectional regressions[55] to estimate the excess returns earned by a portfolio composed by small-capitalization stocks relative to the returns actually predicted by the most reliable evaluation model(the CAPM). The second method, instead , consists in the investigation of the performance of portfolios going long[56] with small capitalization stocks and short[57] with large capitalization ones.

Most of the market inefficiencies were discovered from the empirical testing of the Sharpe-

[55] In statistics and econometrics, a cross-sectional regression is a type of regression in which the explained and explanatory variables are associated with one period or point in time. This type of cross-sectional analysis is in contrast to a time-series regression or longitudinal regression in which the variables are considered to be associated with a sequence of points in time.

[56] Long position: the buying of a security such as a stock, commodity or currency, with the expectation that the asset will rise in value. In the context of options, the buying of an options contract .Opposite of "short position"

[57] Short position: the sale of a borrowed security, commodity or currency with the expectation that the asset will fall in value. In the context of options, it is the sale (also known as "writing") of an options contract. Opposite of "long (or long position)."

Lintner-Black's CAPM. The CAPM basically concerns a linear relation between stocks returns and their sensitiveness to market movements. The only risk factor influencing the stock returns, according to the CAPM, is the parameter "β", measure of the stock's sensitiveness with respect to market movements. Asset's beta (β) is the only determining factor to define the asset price. Accordingly, it should reflect the cross-sectional variations in expected returns. Jensen (1968) provided an analytical definition of the abnormal returns earned by portfolios composed by small-cap stocks, in line with the main principles involved in the CAPM, that is :

$$\alpha_{i:} = R_{it} - R_{it}^{F} - \beta_{i}\,(R_{it}^{M} - R_{it}^{F})$$

"α_i" obviously stands for the abnormal return, R_{it} represents the returns on a portfolio of small capitalization stocks, R^{f}_{it} is the risk-free rate (usually the yield on Treasury Bills) and finally R_m is indicative of the market return. "β", as previously mentioned, is the parameter measuring the sensitiveness of the portfolio with respect to market fluctuations in terms of return.

Banz (1981) collected data from the New York Stock Exchange (NYSE), covering the period 1936-1975 and found statistically significant abnormal returns of 5% earned by the smallest 20% stocks ranked by capitalization, each year .In addition, the smallest stocks belonging to the sample showed a return of 19.8% higher than the largest ones over the analyzed period .Furthermore, Banz inferred about the negative relationship linking actual stocks returns and respective firms' size. Anyways, he wasn't able to ascertain whether the size-factor was the real trigger or if it was some other variable correlated to it.

Banz findings were reinforced when, in 1981, Reinganum (1982) conducted a survey over 566 stocks belonging to both the NYSE and AMEX[58] between 1963 and 1977. His data , showed that the portfolio of stocks situated in the bottom decile by market capitalization, in the period above indicated, outperformed the portfolio of stocks situated in the upper one by an incredibly significant amount, that is by 23,4% every year. Consequently, Brown, Kleidon and Marsh (1983) took advantage of the dataset Reinganum previously built to trace a negative relationship between the logarithm of market capitalizations and stocks' returns . On the same vein, Lamoureaux and

[58] The third-largest stock exchange by trading volume in the United States. In 2008 it was acquired by the NYSE Euronext and became the NYSE Amex Equities in 2009. The AMEX is located in New York City and handles about 10% of all securities traded in the U.S.

Sanger (1989) documented the anomaly even for the NASDAQ[59] . Over the period 1973-1985 the smallest fifth percentile of the NASDAQ's stocks,outperformed by 26.8% the largest one, whereas the smallest fifth percentile of the NYSE/AMEX outperformed the largest one by 22.4%. Summarizing, Banz's findings obtained large consensus among other economists and their surveys, purely relative to US.

Nevertheless, the SFE is not a typical US phenomenon. Global equity data seems to suggest that the phenomenon has always assumed a global entity. Annaert, Van Holle, Crombez and Spinet (2002), analyzed the trend of European stocks between 1974 and 2000. The results of their search was a monthly SFE of about 1.5% registered in a sample of 2866 stocks, but such findings were not enough to ascertain the statistical significance of the anomaly. Few years later Leledakis, Davidson and Smith (2004), studied the behavior of 1420 stocks belonging to the London Stock Exchange, during the period 1974-2000. Thanks to the employment of econometric techniques, they found substantial evidence of the SFE, even in the UK market. Similarly, Beetles (1992) published an analogous survey regarding the Australian stock market, while Stehle (1987) analyzed the behavior of the German stock market from 1954 and 1990 and finally Rouwenhorst (1999) registered a considerably high small-capitalization premium for stocks belonging to emerging stocks market between 1975 and 1997. Even if small sample biases[60] could have slightly affected the results obtained by the above mentioned surveys, there is enough evidence to assert that the SFE appeared to be globally widespread.

In the same years the SFE was initially individuated, a lot of other relevant anomalies had begun to be discovered. In particular ,securities ranked according to criteria such as the book to market ratio as suggested by Rosenberg, Reid and Lanstein (1985), the price momentum (Jagadeesh and Titman (1993)) , the leverage (Bhandari (1988)) and dividend yield (Fama and French (1988)) were all observed to produce returns in excess of what the CAPM suggested. The mounting evidence of the divergence between reality and predictions by CAPM caused economists to question the adequacy, validity and exactness of that model. Those that were considered anomalies, instead, could have been simply the evidence of the inadequacy of such a pricing model. Fama &

[59] A global electronic marketplace for buying and selling securities, as well as the benchmark index for U.S. technology stocks. Nasdaq was created by the National Association of Securities Dealers (NASD) to enable investors to trade securities on a computerized, speedy and transparent system, and commenced operations on February 8, 1971. The term "Nasdaq" is also used to refer to the Nasdaq Composite, an index of more than 3,000 stocks listed on the Nasdaq exchange that includes the world's foremost technology and biotech giants such as Apple, Google, Microsoft, Oracle, Amazon, Intel and Amgen.

[60] A type of bias caused by choosing non-random data for statistical analysis. The bias exists due to a flaw in the sample selection process, where a subset of the data is systematically excluded due to a particular attribute. The exclusion of the subset can influence the statistical significance of the test, or produce distorted results.

French (1992) in fact were the first to reject the appropriateness of the model, evidencing how firm size and book-to-market equity consisted in a robust characterization of the cross-section of stock returns. In accordance to previous surveys, Fama and French registered the small-capitalization stocks outperformance over large-cap ones, analyzing the NYSE, AMEX and NASDAQ between 1963 and 1990. In addition, they traced a positive relationship between a firm size and its equity's beta (β). According to their analysis, every beta was almost perfectly correlated to firm size, thus tests on size portfolio alone, were not sufficient to adjust for the influence of beta and firm size on cumulative average returns. Finally, once the two economists performed a test in which stocks were sorted by market betas, they found that the correlation between the average returns and the market betas was almost insignificant and consequently that average returns were strongly conditioned by the size factor. They indeed concluded that it could be one of the most influential determinant of portfolios ' returns along with the market factor.

To evaluate the extent of the Small Firm Effect along with the Value Effect[61], Fama and French composed two factor mimicking portfolios, constructed according to criteria of book to market and firm size. Every year starting from 1926, precisely in June, US stocks recorded in CRSP[62] were sorted according to each security's capitalization and book to market values. For what concerned the ranking based on book to market, all stocks were divided into three subcategories: the 30% with the highest book to market ratio, the 30 % with the lowest and the remaining 40% situated in the middle, called "neutral". A long-short portfolio that attempted to simulate the small cap premium (SMB: Small Minus Big) was constructed by going long the smallest 30% whereas going short the highest 30% in each of the three subcategories previously defined. On the other hand, the value factor portfolio was constructed following almost the same procedure. The two economists adopted the double sort mechanism about size and value with the intent of eliminating any value bias in the small-cap factor and vice versa. Fama and French furthermore obtained small-

[61] The Book-to-Market effect is probably one of the oldest effects which has been investigated in financial markets. It compares book value of company to price of the stock - inverse of P/B ratio. The bigger the book-to-market ratio is, the more fundamentally cheap is the investigated company. Book-to-Market wasn't even considered as a market anomaly at the beginning of the century when Ben Graham famously popularized its use. The ratio lost some of it popularity when the Efficient Market Theory and CAPM became main Wall Street theories, but it gained back its position after several studies have shown the rationality of using it. This anomaly is well-described in the classical Fama and French research paper (1993). Additional details are calculated from data which are presented in Kenneth French data library (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). Pure value effect portfolios are created as long stocks with the highest Book-to-Market ratio and short stocks with the lowest Book-to-Market ratio. However, this pure value effect has substantial drawdowns with more than 50% drawdown in the 1930s. Value factor is still a strong performance contributor in long only portfolios (formed as long stocks with highest Book-to-Market ratio without shorting stocks with low Book-to-Market ratios).

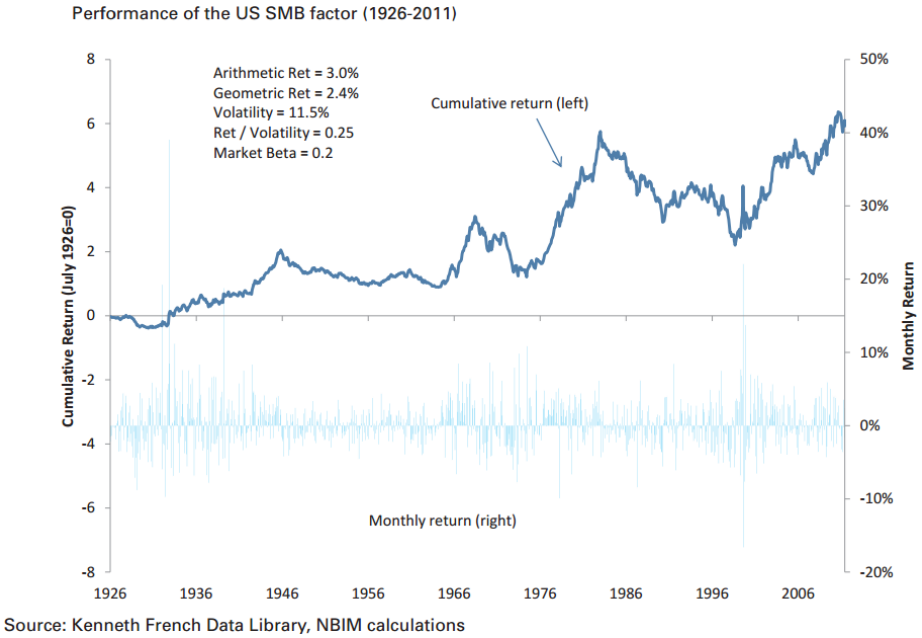
[62] A research center at the University of Chicago Graduate School of Business. The Center for Research In Security Prices (CRSP) is a vendor of historical time series data on securities. CRSP is a non-profit center that is used by academic, commercial and government agencies to access information such as price, dividends and rates or returns on stocks.

cap factors for other areas of the world such as Europe, Japan, Pacific Asia and North America and even a global factor for the overall developed world. The methodologies according to which Fama and French evaluated such small-cap factors were identical with respect to the one previously mentioned, with the exception that the breakpoints needed for the selection of small and large stocks were taken at different levels. For the global portfolio instead, global size and region-specific book to market breakpoints to subdivide the corresponding stocks of the global portfolio were adopted. The SMB even in this case, represented an equally weighted long position in the small-capitalization stocks and a corresponding equally weighted short position in the large-capitalization stocks in the three book to market buckets.

As it can be noticed from Figure 3.2, US small-cap stocks had outperformed large-cap ones by an average factor of 3% every year between 1926 and 2011.Anyways the substantial small-cap premium is somehow weighted by the increased risk involved in such stocks. The chart in fact, clearly evidences the accentuated factor's volatility (11.5% every year). The factor's performance in fact, appeared not to be constant over time. Periods of positive performance were alternated by negative periods.

Performance of the US Small minus Big factor over the period 1926-2011

Figure 3.2



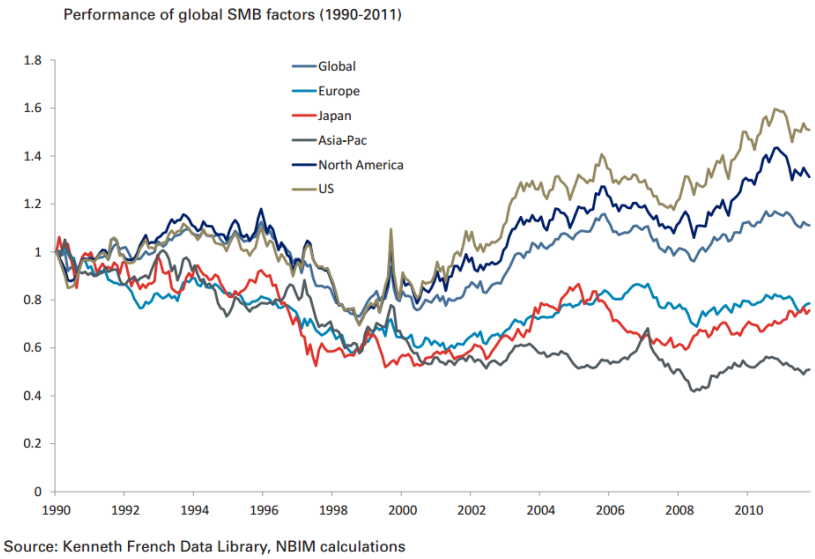
Source:Kenneth French Data Library, NBIM calculations

On the other hand, considering the period between 1990 and 2011 and the global scenario, Fama and French's data suggested that US SMB factor performed better relative to other regions, namely the European one, the Asia- Pacific, the Japan and the North America. Particularly in recent years the gap between the US SMB factor and the SMB factors of the other regions significantly

deepened as it can be easily identifiable by Figure 3.3:

Performance of the Small minus Big factor all over the world (1990-2011)

Figure 3.3



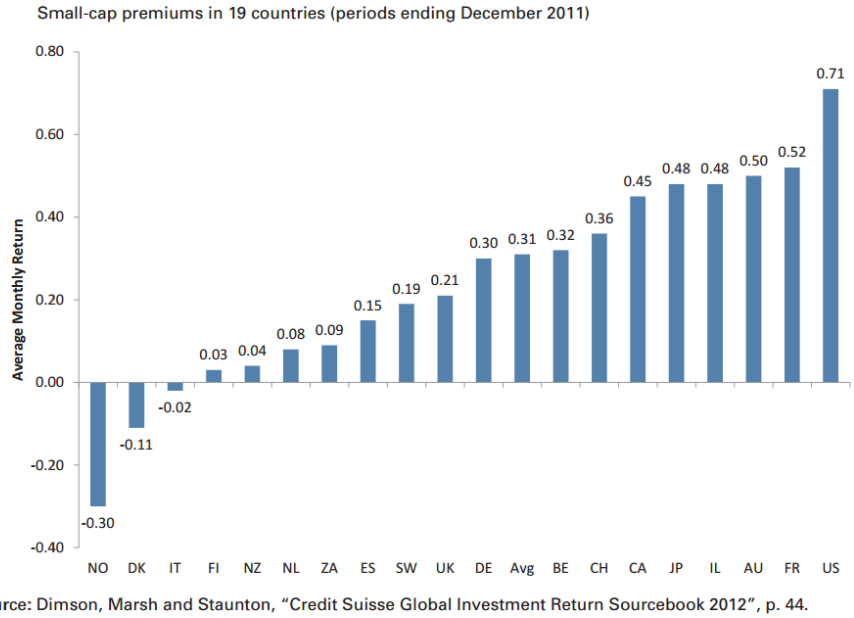
Source:Kenneth French Data Library, NBIM calculations

To further validate the hypothesis sustaining the robustness of the SFE across countries, the MSCI[63], a US financial institution, conducted a detailed survey in which it collected the average monthly return differentials for the nineteen most developed markets around the world. The time horizon according to which the survey was structured aimed at being the longest possible for each country, namely the longest time span in which detailed data were available. For instance the search regarding Norwegian case, counted twelve years of full data availability, whereas the survey about US enumerated 81 years of full data availability. Results were quiet consistent with Fama and French findings. The small-capitalization premium was found to be positive in 17 out of the 19 studied countries, ranging from -0.30 % for Norway to 0.71 % for the USA. Remarkable evidence was the superior effectiveness of the SFE in the US capital markets, relative to other countries. Anyway, the overall positive average influence of the size factor was delineated to be 0.31% per year. All these findings are summarized in the following graph :

[63] An investment research firm that provides indices, portfolio risk and performance analytics and governance tools to institutional investors and hedge funds. MCSI provides these clients with investment tools from Barra, Financial Engineering Associates, RiskMetrics, Institutional Shareholder Services, Measurisk and the Center for Financial Research and Analysis. It also publishes indices that are widely available to the investing public. MSCI is a publicly traded company on the New York Stock Exchange. It is no longer part of Morgan Stanley.

Country-specific size factor performance

Figure 3.4



Source:Dimson, March and Staunton,"Credit Suisse Global Investment Return Soucebook 2012"p.44

3.2.1. Has the Small Firm Effect shown itself constant over time?

As previously debated, the SFE exhibited wide swings in performance over time and a lot of scholars such as Brown, Kleidon and Marsh (1983) tried to analyze the persistence of such phenomenon under a long-run perspective. Once ascertained the effectiveness of the anomaly in absolute terms, they realized it was pretty unstable over time. Their study focused on the performance of ten size-sorted portfolios composed by stocks belonging to the NYSE and the AMEX. They traced a positive relationship between risk-adjusted returns and size over the period f 1967-1979, asserting in addition, that the sign and the magnitude of such relationship were not stable over time. To effectively understand the volatility of such phenomenon, it's sufficient to report their findings for two different time periods. From 1967 to 1975 the average small-cap premium they registered was a negative premium, namely – 7%, whereas from the following year up to 1979 the rout appeared reverted, in fact, a huge small-cap premium of 37.3% was recorded. Furthermore the econometric analysis they performed failed to reject the hypothesis of the SFE being stable over time and reinforced the hypothesis sustaining the mutual dependency and volatility of the phenomenon relative to the time period in which it is observed.

Furthermore, surveys conducted in the late 1990s evidenced the diminishing intensity and effectiveness of the anomaly at the point that it was near to disappear. Dichev (1998) studied US

equity markets and he observed the lack of empirical evidence proving the SFE during the period from 1981 to 1998. In fact the difference between the average monthly returns of small-cap stocks and large-cap ones was negative in both the exchanges: the NYSE and the AMEX. In addition, data resulted to be statistically significant at 95 %. Similarly, Fama and MacBeth (1973) performed a study in which they constructed a regression relating individual stock returns to the probability of bankruptcy[64] of the corresponding firms, the firms' market value and finally the firms' book to market. Results indicated that there wasn't a statistical significant relationship between the size factor and the firms' returns. However the most comprehensive and articulated research was the one presented by Horowitz, Loughran and Savin (2000). In analyzing the three US most fundamental capital markets from 1980 to 1996 (the NYSE, the AMEX and the NASDAQ), the three economists didn't collect data in support of the SFE hypothesis, on the contrary they denied the presence of a correlation between firms' size and respective returns. The results they obtained showed that in average, the smallest decile of stocks ranked by market capitalization underperformed the largest decile by 1.18% over the investigated period. Moreover no statistical significant relationship between realized returns and the logarithm of market capitalization was found.

Based on Fama and French's finding about the SMB factor ,Pekkala (2005) noticed that the period in which the Small Firm Effect had shown itself more intensively in US capital markets, was in the five-year period from 1975 to 1980, namely a few years before its discovery. Likewise, Pekkala observed that the phenomenon was more profound in periods of economic expansion. According to his results, during economic contraction, small-cap stocks underperformed the market by a statistically insignificant 0.4% per year and on the contrary outperformed it by 3.8% per year in periods of economic booms. Starting from 1981, instead the SFE decisively attenuated and according to Pekkala's conclusions, no statistical significant abnormal returns for small stocks were registered from that year on. Similar to US, the forcefulness of the SFE attenuated in other areas of the globe in recent years. Fama and French (2011) collected data about all the four regions of the world, namely Asia-Pacific, Europe, Japan and North America. Based on the observation of stocks returns from 23 different countries from November 1990 to March 2011, they deduced no significant SFE for any of the regions under analysis. Actually the average SFE in Europe, Asia Pacific and Japan was registered to be slightly negative in that period taken under consideration, whereas the global SFE according to empirical data was about 0.1% per month, but even deeper

[64] A legal proceeding involving a person or business that is unable to repay outstanding debts. The bankruptcy process begins with a petition filed by the debtor (most common) or on behalf of creditors (less common). All of the debtor's assets are measured and evaluated, whereupon the assets are used to repay a portion of outstanding debt. Upon the successful completion of bankruptcy proceedings, the debtor is relieved of the debt obligations incurred prior to filing for bankruptcy.

analysis couldn't attribute the statistical significance to such outcome, in fact the computed t-statistic was only 0.69.

At a later stage, Dimson and Marsh (1999) asserted that not only the Small Effect attenuated during the years between 1980s and 1990s but also that in reality it reversed its causality. Their conclusion were derived from the survey they drew up in which the performance of the smallest tenth of UK companies by market capitalization (grouped by the HGSC index[65]) was compared with an index of a portfolio entirely composed by heterogeneous equities. Data were relative to the period 1955-1997. The average return for the HGSC index was registered to be 24.5% in average between 1955 and 1986 while the portfolio showed a return of 18,6% per year, averagely. Indeed, the average SFE registered in that period was 24.5%-18.3% = 6.2% per year. To ascertain the validity of the effect, a t-test was performed and the result was quite comforting; it was about 2.46. Anyways in the following ten years the HGSC index earned an average yearly return of 10.6% while the all-share portfolio earned a return of 17.1%. Hence in that time period, the SFE seemed to be reversed and in addition the negative effect was found to be statistically significant at the 90% confidence level.

Even if authors had consistent material to document the diminishing intensity of the SFE starting from the early 1980s, years in which it had been discovered and analyzed for the first time, it seems premature to assert that it has completely disappeared nowadays. Van Dijk (2011) argued that stocks returns are usually noisy and moreover standard errors relative to estimations are inevitably large and that for these reasons it would be a mistake to draw early conclusions about the anomaly over small samples. Furthermore, his studies evidenced a mean SFE of 11.3% per year from 2001 to 2010 that according to him was the tangible proof of a reversal in the trend of the previous decades. Besides, Van Dijk asserted that the diminishing intensity of the SFE, since the 1980s, may be reinterpreted as a transitory phenomenon caused by information surprises that made realized returns sharply diverge from expected ones, rather than a real shift in expected returns.

The Norges Bank Investment Management[66] provided investors with an in depth analysis aimed at evaluating whether the SFE had really declined after 1981 and even reversed after 2000. CAPM equations, including time-period dummies[67] and a Chow-test[68] for structural breaks on the

[65] The Hoare Govett Smaller Companies Index: it covers the bottom 10 per cent by value of the UK stock market.It has now been extended back to 1955 and also boasts various derivations - such as the HG1000, the smallest 1,000 stocks, and the HSGC plus Aim (Alternative Investment Market).

[66] Norges Bank / Noregs Bank is the central bank of Norway. Apart from having traditional central bank responsibilities such as financial stability and price stability, it manages The Government Pension Fund of Norway, a stabilization fund that may be the world's largest sovereign wealth fund. The limited transparency of some SWFs makes it difficult to make accurate assessments of their assets under management

[67] In statistics and econometrics, particularly in regression analysis, a dummy variable (also known as an indicator

estimated alpha[69], were constructed. Not surprisingly, results (reported in Table 3.1) indicated the diminishing intensity of the anomaly after 1980 and a significant reversal in 2000. With respect to the sample composed by data relative to prior to 2000, the negative alpha coefficient for the post-1981 indicated that, since then, the SFE had been always less and less effective. Between 1981 and 2000 the anomaly consisted in a return of -22 monthly basis points (-0.22% every month). Even if the analyzed coefficients were only marginally statistically significant, the Chow-test evidenced the occurrence of a structural break in the data in 1981. A similar break was recorded in 2000. After 2000 in fact, as the positive alpha coefficients for the post-2000 suggested, the SFE started to acquire again relevance and incisiveness. The main conclusion to be deduced is that even if it could be the case for a lot of investors, the SFE has not deceased yet, as Table 3.1 suggests.

Structural breaks in the Small Firm Effect in US (1927-2011)

Table 3.1

Structural breaks in the SFE (US data, 1927-2011)

	Pre-2000 (1927-1999)			Post-1981 (1981-2011)	
	Estimate	t-stat		Estimate	t-stat
Alpha pre-1981	0,17	1,39	Alpha pre-2000	-0,20	-0,96
Alpha post-1981	-0,22	-1,29	Alpha post-2000	0,84	1,82
Difference	-0,39	-1,67	Difference	0,64	1,98
Structural break in 1981?	Yes		*Structural break in 2000?*	No	
Chow test F-statistic	3,73		Chow test F-statistic	3,55	
p-value	0,02		p-value	0,03	

Source: Kenneth French Data Library; NBIM calculations

Source: Kenneth French Data Library, NBIM calculations

variable, design variable, Boolean indicator, categorical variable, binary variable, or qualitative variable) is one that takes the value 0 or 1 to indicate the absence or presence of some categorical effect that may be expected to shift the outcome. Dummy variables are used as devices to sort data into mutually exclusive categories (such as smoker/non-smoker, etc.) For example, in econometrictime series analysis, dummy variables may be used to indicate the occurrence of wars or major strikes. A dummy variable can thus be thought of as a truth value represented as a numerical value 0 or 1 (as is sometimes done in computer programming).

[68] The Chow test is a statistical and econometric test of whether the coefficients in two linear regressions on different data sets are equal. The Chow test was invented by economist Gregory Chow in 1960. In econometrics, the Chow test is most commonly used in time series analysis to test for the presence of a structural break. In program evaluation, the Chow test is often used to determine whether the independent variables have different impacts on different subgroups of the population.

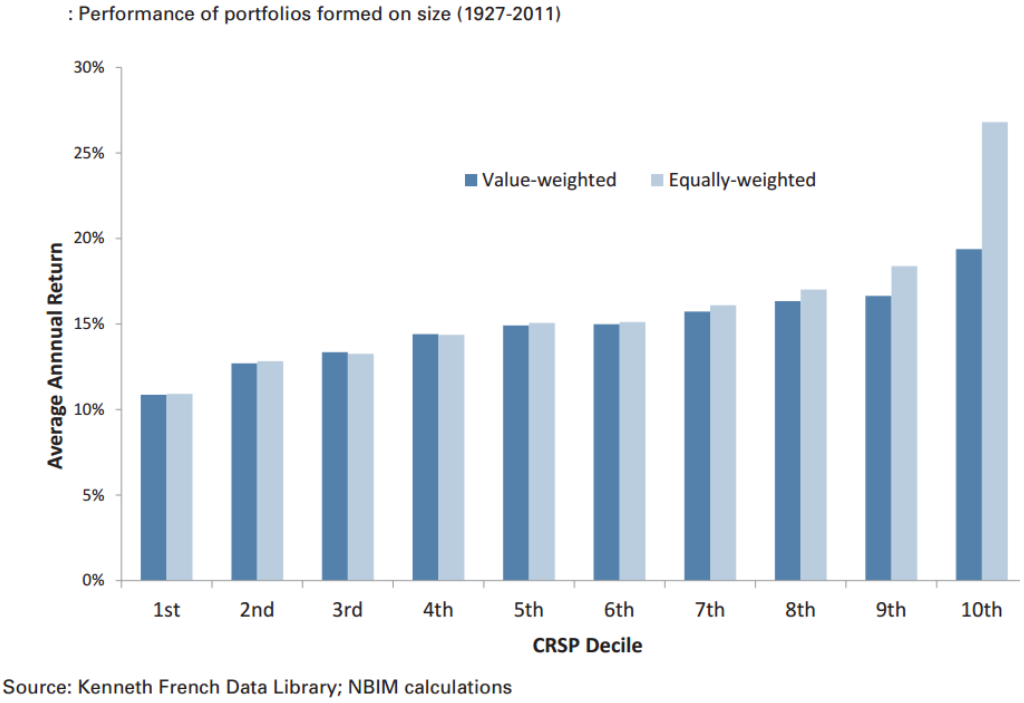
[69] The abnormal rate of return on a security or portfolio in excess of what would be predicted by an equilibrium model like the capital asset pricing model (CAPM).

Another interesting feature related to the SFE is the nonlinearity according to which the anomaly showed itself among different levels of capitalization stocks. In particular, Horowitz, Loughran and Savin (2000) found out that the effect is usually much more pronounced for the smallest equities of the evaluated portfolio. Their survey was conducted through the analysis of different portfolios composed by US stocks arranged into them by increasing capitalization levels. They considered the period from 1963 to 1997. The three economists found a solid evidence of the SFE but furthermore argued that such anomaly was no more visible when stocks belonging to firms with a market capitalization of five million or less were removed from the sample. The main conclusion, they derived, is that smallest capitalization firms represented the real driving force of the effect. In accordance with results provided by Horowitz, Loughran and Savin, other two scholars, Knez and Ready(1997) found ,few years before, no evidence of the SFE once correcting for outliers in the stock return data of the sample they constructed. Moreover, thanks to a particular regression estimator, able to correct for most extreme observations, they observed no statistical significance of the correlation coefficient between stocks return and firms' capitalization over the period 1963-1990. The main inference they traced was that the SFE was particularly driven by the smallest capitalization stocks of the sample.

Figure 3.5 shows Cumulative Annual Returns for groups of stocks ranked by capitalization rate and arranged in deciles belonging to the CRSP database. As it can be easily interpreted, when stocks are weighted by market capitalization, those belonging to the bottom decile outperform those belonging to the upper decile by almost 6% per year. When instead all stocks are equally weighted the effect seems much more amplified. This suggests that when returns of small firms acquire a higher weight in average annual returns computations; the anomaly is far more evident, indicating that abnormal returns are typical of the very small capitalization stocks.

Cumulative annual returns of ranked by size portfolios (1927-2011)

Figure 3.5



Source: Kenneth French Data Library, NBIM calculations

3.2.2. Is the Small Firm Effect a seasonal phenomenon?

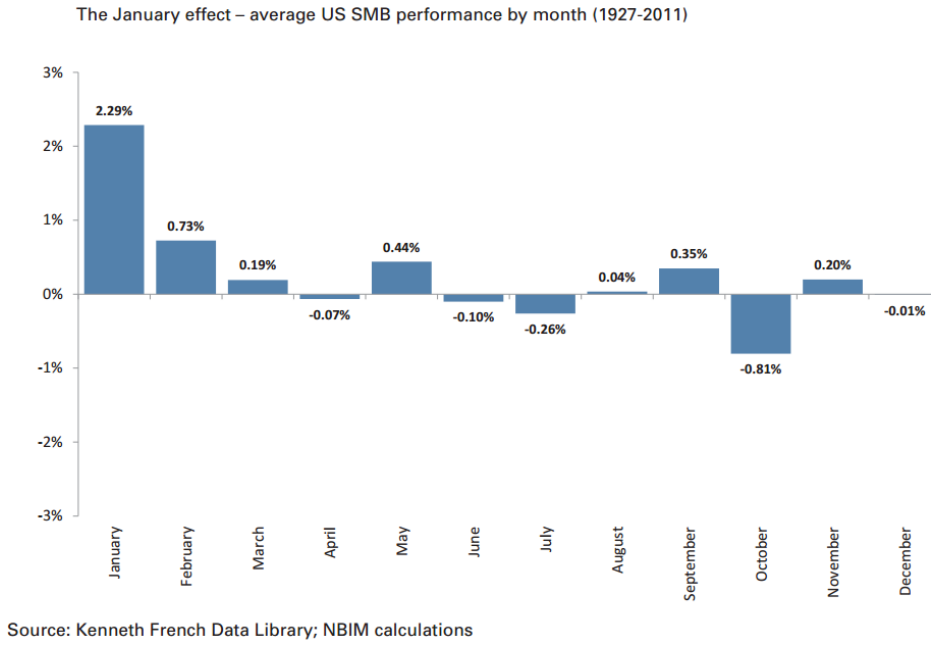
Most of the scholars who studied the SFE, have acknowledged the improved and superior effectiveness of the phenomenon during the month of January. Keim (1983) observing a sample of US stocks over the period 1963-1979, found out that almost 50% of the abnormal returns earned by the smallest capitalization stocks were realized in the first month of the year, January. Furthermore he argued not only that 26% of the abnormal returns were registered to be earned during the first week of January but also that the 11% were registered on the first trading day. He noticed that on the 1st January , the difference in returns between small and large capitalization stocks was always positive in each year the survey covered, and moreover that such differential was discovered to be statistical significant at the 99% confidence level.

Recalling the notion of the SMB factor proposed by Fama and French (2011) discussed in the previous paragraph, Figure 3.6 shows the average level of such factor for each month of the year for all stocks belonging to the CRSP database. The time coverage included all years between 1927 and 2011. As the figure clearly expresses the level of the SMB factor resulted sensibly higher in the month of January and almost null in the remaining months, or at least not statistically significant

from zero. More specifically in the months of April, June ,July and October the SMB factor was registered to be even negative, but again coefficients do not indicate a considerable statistical significance. Moreover the main suggestion Figure 3.6 provides is that nearly all the average SFE registered over the period 1927-2011 ,was mainly attributable to the January Effect.

US Small Minus Big factor performance for each month (1927-2011)

Figure 3.6



Source: Kenneth French Data Library, NBIM calculations

Another interesting feature regarding the January Effect and its complementarity with the SFE, is that, as suggested by tests and estimates of January alpha coefficients for different time periods and by tests for structural breaks similar to the ones previously presented for the SFE, the January Effect didn't declined after the 1980s differently from the SFE, or at least it did, but a much lower rate. The Norges Investment Bank which, as previously mentioned, elaborated a very precise and complete search about the SFE, argued that even if the January Small Firm Effect declined by 212 basis points after 1980 it still remained positive until 2000. From 2000 on, the January Small Firm Effect was found to be always positive and slightly higher but not in a statistical significant way. As it can be inferred by the following table, the SFE relative to the month of January had been decreasing after the 1980s but it had always influenced the overall Small Firm Effect in a significant manner.

January Effect intensity (1927-2011)

Table3.2

The January effect (1927-2011)

Jan, pre-2000 (1927-1999)	Estimate	t-stat	Jan, post-1981 (1981-2011)	Estimate	t-stat
Alpha pre-1981	2,75	6,71	Alpha pre-2000	0,40	0,56
Alpha post-1981	0,63	0,87	Alpha post-2000	1,48	1,10
Difference	-2,12	-3,45	Difference	1,08	0,95
Structural break in 1981?	Yes		*Structural break in 2000?*	No	
Chow test F-statistic	7,48		Chow test F-statistic	2,26	
p-value	0,00		p-value	0,12	

Source: Kenneth French Data Library; NBIM calculations

Source:Kenneth French Data Library; NBIM calculations

3.2.3. Recent Empirical Evidence

To provide the widest possible picture, I personally decided two conduct two parallel surveys aimed at evaluating the effectiveness of the SFE in recent years , more specifically in the last decade.

Both the surveys, share the same data source, namely Osiris[70], with the main difference that the first investigated the London Stock Exchange, while the second one focused on the NYSE.

The SFE in the London Stock exchange.

Methodology:

As previously mentioned, data were obtained from a unique source, Osiris .

I decided to strictly focus on the London Stock Exchange, for basically two reasons:

1. Various preliminary trials let me realize that the London Stock Exchange, along with the NYSE was one of the exchanges with the highest degree of data availability.

[70] a fully integrated public company database and analytical information solution produced by Bureau van Dijk Electronic Publishing, SA (BvDEP)

2. All researches discussed in this thesis didn't question the validity of the SFE in an European country and if they did, they superficially approached the subject.

The intent, was to construct two portfolios, one composed by small cap stocks and one composed by large cap ones and successively to analyze their relatives performances over the time-period from 2005 to 2014, comparing monthly closing prices and returns for each of the ten year taken into consideration.

In particular, the portfolio composed by small capitalization stocks, was composed by shares of small and micro enterprises according to the criteria set by the European Commission, reported, on the *Official Journal of the European Union*, the 6th of May 2003. Indeed, the Commission Recommendation, established that in order to be defined "small" ,an enterprise had to match the following criteria:

1. Number of employees < 50,
2. Turnover ≤ 10 mln of euros , or alternatively
3. Balance sheet total ≤ 10 mln of euros.

Whereas to be defined "micro":

1. Number of employees<10,
2. Turnover ≤ 2 mln of euros, or alternatively
3. Balance sheet total ≤ 2 mln of euros

At the end of the selection process, out of the 1962 stocks registered on the London Stock Exchange, only 39 met the criteria set by the European Commission and were assembled to compose the Small firms Portfolio.

One crucial point is that those criteria were met only for the last four years of the time-span the survey covers (since 2011 up to 2014) simply because it seems reasonable to assume that a firm that over the last four years respected the previous mentioned parameters, has always respected them for most of the cases.

The Large firms Portfolio instead, was composed by equities of firms registered on the London Stock Exchange that contemporary belonged to :

1. The group of the Top 50 firms by number of employees for the years 2011,2012,2013,2014

2. The group of the Top 50 firms by Total Assets for the years 2011,2012,2013,2014

3. The group of the Top 50 firms by Operating Revenue for the years 2011,2012,2013,2014

Clearly, all the firms that survived to the selection process largely overstep all the criteria aimed at identifying those firms which are not considered neither small nor medium, according to the previously debated criteria set by the European Commission. In such a way the two groups of selected firms are the most heterogeneous possible.

In this case, the selection process, ended up with the Large Firms Portfolio being composed by 32 stocks, and this was quite comforting, since both the portfolios contained a similar number of shares and were homogeneous in that sense.

Results:

Once the two portfolios were constructed, their absolute and relative performances were compared over the above mentioned ten-year period (2005-2014).

Results can be summarized by the following graph :

Portfolios' performances: a comparison between Small Firms and Large Firms Portfolio annual returns from 2005 to 2014

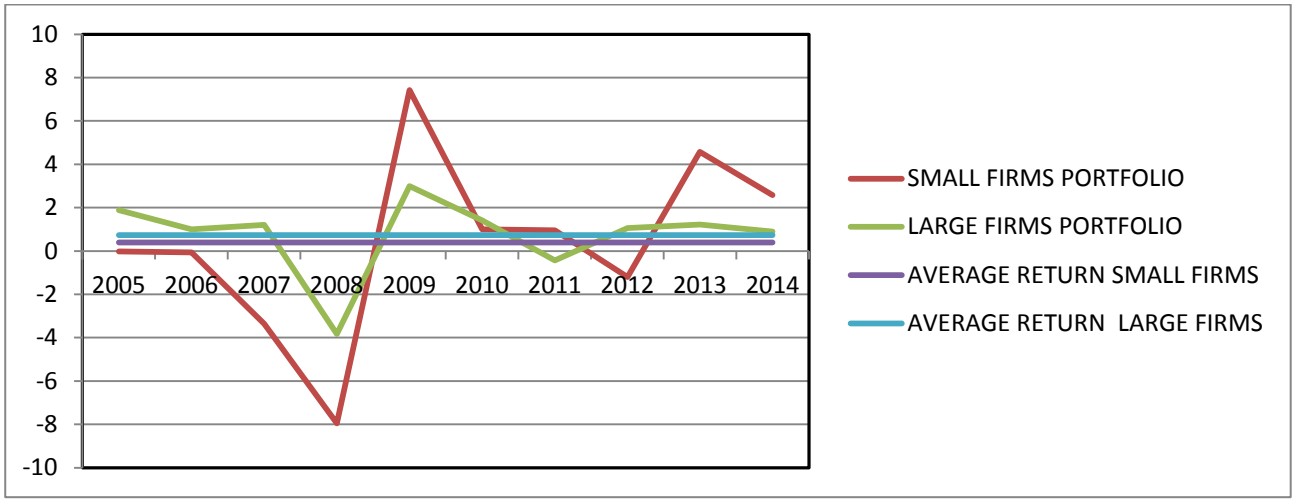


Figure 3.7

Figure 3.7 shows the yearly returns (measured on the vertical axes) for each of the ten years (reported on the horizontal axes) collected by both the portfolio composed by small firms and by the

portfolios composed by large ones. Yearly returns were computed as the average of the registered monthly returns for each year.

As it can be easily noticed, since 2005 to 2008, the Large Firms Portfolio, clearly outperformed the Small Firms one, which reflected a substantial negative performance, with returns approaching -8% in 2008.

Nevertheless, from that year on, the Small Firm Portfolio mostly outperformed the Large Firm one, as the SFE theory predicts, except for few months in 2010 and the whole 2012.

In addition the graph suggests the higher volatility of the Small Firm Portfolio with respect to the Large Firm one.

In the end, the overall average return for both small and large firms, was plotted on the graph and as it can be simply observed ,on average, the Large Firm Portfolio collected higher returns than its opponent. Data analysis, confirmed that it did by 0,348% over the ten-year period (2005-2014).

Anyway, a comparison of the small returns differential with the variances of both the Small Firms and Large Firms Portfolio's returns (respectively 17, 65% and 3, 11%) reveals its statistical insignificance.

The SFE in the NYSE

The second survey, instead, investigated the effectiveness of the SFE in the NYSE as Brown, Kleidon and Marsh(1983) , Fama and French(1992) and others did in the past.

Methodology:

Two differently sized portfolios were constructed and their relative and absolute performances were analyzed over the ten-years period from 2005 to 2014, comparing monthly returns for each month of the ten years under analysis.

The data source is Osiris also for this analysis and the two portfolios were constructed according to precise criteria. The Small Firms Portfolio was composed by stocks belonging to :

1. The lower quartile of stocks registered on the NYSE ranked by Total Assets for the years 2011,2012,2013 and 2014 and

2. The lower quartile of stocks registered on the NYSE ranked by ascending Number of Employees for the years 2011,2012,2013,2014

The search ended up with 34 equities from the NYSE composing the Small Firms Portfolio. I decided to adopt such selection strategy since the "Number of Employees" parameter and the "Total Asset" one ,in particular, are positively and undoubtedly correlated to a firm's size, hence the contemporary adoption of such criteria in stocks sampling may be considered a reliable methodology to identify small firms. Furthermore, the necessity to obtain a considerably populated sample, forced me not to add to the search strategy, additional discriminating criteria such as constraints on market capitalizations or operating revenue.

In this case as well, it is reasonably assumed that firms respecting the search criteria for the last four years have always respected them and hence have always been small firms according to the above provided definition. Once again, limitations imposed by the database forced me to formulate such assumption that in any case doesn't seem to be absurd.

On the other hand equities composing the Large Firms Portfolio , simply belonged to the top 50 firms of the NYSE ranked by market capitalization for the years 2011,2012,2013 and 2014. Firms matching the criteria were only 38 and composed the Large Firms Portfolio. Again, firms that belonged to the top 50 by market capitalization for the last four years , may be reasonably assumed to have been in the top 50 even in the previous years or in a similar position.

Results :

Once the two portfolios were constructed, their relative and absolute performance were compared over the time period from 2005 to 2014. In particular, as in the previous analysis, monthly closing prices were converted in monthly returns, in order to structure a consistent returns' comparison.

Results may be summarized by the following chart:

Portfolios' performances: a comparison between Small Firms and Large Firms Portfolio annual returns from 2005 to 2014

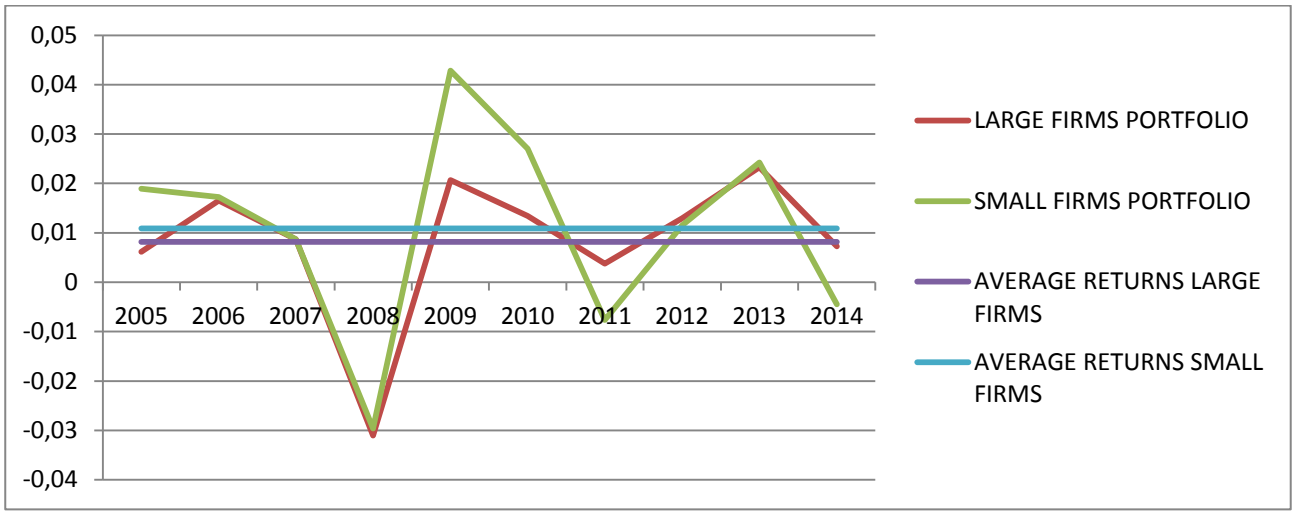


Figure 3.8

As the chart clearly suggests, it is evident how the Small Firms Portfolio outperformed the Large Firms one for most of the time span under analysis. Specifically, from 2005 to 2011 the Small Firms Portfolio, offered always better returns than its opponent portfolio. In the following years ,only for short periods (from February 2011 to May 2012 and from August 2013 on), the Large Firms Portfolio, obtained slightly higher returns than the portfolio composed by equities of small firms. On average over the ten-years period analyzed, the Small Firms Portfolio outperformed the Large Firms one by 0,27%.

Comments

The results I obtained from the above presented surveys may be considered satisfactory to certain extents while contradictory to others. Anyway, gathered evidence, has to be analyzed at the light of some influencing factor.

First of all, it might be the case (as suggested by MacKinlay (1990) and Black (1993)) that the sample selection process has been carried out according to biased criteria, unable to individuate the real sample of interest. In addition, as a matter of fact, a lot of data were missing, especially for small firms in the earliest years both the surveys covers. Data inaccuracy may have biased the obtained results. Moreover, consistently with Fama and French (1996) , in both the analyses , returns of Small Firms Portfolio reflected a sensibly higher variance than returns of the Large Firms Portfolio. Such variance differential may indicate the higher risk involved in holding small firms stocks. As a reward for the improved risk-bearing, small firms shares provide

investors who have bought them with higher returns. The inquiry related to the NYSE clearly evidences this aspect.

Lastly, it could be also the case that the London Stock Exchange patterns have been more intensively hurt by the eurozone financial crisis that officially started in 2007 but whose first signs were perceptible even some years before. In periods of financial instability the firms which are harder hurt, are obviously the smaller ones, since they lack the means to stably face the contingency. As a consequence, their equities value visibly diminishes. In US instead, were the crisis has been much less severe than in Europe, the SFE is still traceable. In addition, as previously mentioned, even if the SFE may go through periods of underperformance, it has always shown itself more pronounced in US probably due to the intrinsic structure of its capital markets. Once again, this is the case.

3.3. What are the main causes of the Small Firm Effect ?

Once profusely presented and discussed the empirical evidence in favor of the SFE, the following paragraph will discuss the possible causes and drivers of such expression of market inefficiency. The argumentation will be structured in three sub-paragraphs, each one analyzing the issue under a different perspective. The nature of the SFE is considered to be multiple. Indeed, most of the surveys, the economic community performed ,tend to justify the anomaly according to three different theories, one for each paragraph.

The first theory that will be debated, regards the SFE, intended as the direct result of statistical estimation errors, the second one, instead, assures that the main driver of the SFE is the superior risk involved in owning stocks of smaller and non affirmed firms and finally the third more recent theory analyzes behavioral biases and institutional factors as possible causes of the effect.

3.3.1. May statistical estimation errors justify the Small Firm Effect?

Many economists assured that most of the departures from the Market Efficiency Hypothesis, traced in financial markets through hypothesis testing were not existing in realities and that the results of such tests were poorly significant in the sense that the discovered anomaly could only be due to the peculiarity of the sample taken under consideration or simply to biases in methodology or data inaccuracy. Lo and MacKinlay (1990) and Black (1993) asserted that a significant number of economists used always the same dataset to test for stocks' prices anomalies.

The usual practice adopted by whatever researcher was to exploit the same dataset to test hundreds of hypothesis ,aiming at verifying their validity and then publishing the most clear and surprising ones. Nevertheless the statistical reliability of those inferences was at least doubtful. Sometimes it could have also happened that a new uncovered anomaly had arisen just by chance. In that case the documented anomaly didn't survive in real financial markets; it was simply a peculiarity of the sample. Black (1993) asserted that the SFE had always represented an anomaly strictly related to the particular analyzed sample and not a universally well established abnormality. Nevertheless in recent years, McLean and Pontiff (2012) published a research they conducted on the returns predictability of different market peculiarities (including the SFE) and on the "out of sample" and post publication decay analysis to estimate the probabilities according to which inferences deduced by samples analysis were reliable . They concluded that a decrease in the predictive ability by a moderate 30 % occurred once surveys were published.

Lo and MacKinley (1990) suggested in addition that deviations from normal returns caused by a firm's size could also be due to statistical inferences issues, occurring because of stocks' selection biased methodologies, applied to construct portfolios that had to be the subject of analysis. According to the two economists, on an ex post basis, deviations from returns predicted by the CAPM could always be registered. Nevertheless those deviations didn't reflect stocks differences in fundamentals but instead were the result of grouping stocks with the same disturbance element in the same portfolio. The main issue was that as long as portfolios were composed by stocks who were empirically found to be sensitive to the same extent to a certain variable or if the variable is indeed traced in the sample, tests would have always suffered from such data snooping biases. The main conclusion they deduced was that under certain reasonable assumptions this kind of biases could lead to the rejection of the null hypothesis that the alpha coefficient of the CAPM is zero with full probability even if the null hypothesis could have been true in reality.

B.Berk (2000), researcher at the Stanford Business School, presented similar arguments. He thought that whenever sorting stocks according to a certain variable that is correlated with returns, the average return of each group of stocks will show the same correlation. Consequently, differences in returns within the group were almost insignificant or at least too low, while difference across groups of sorted stocks were much more significant. The main outcome is that the ability of a model to price assets will result smaller within the group than in the whole sample. Every sorting mechanism involves a bias towards rejecting the adopted asset pricing model.

Most of the authors concerned in demonstrating the SFE, tried to demonstrate two different things: downward biases in riskiness measures of small capitalization stocks or alternatively,

upward biases in measuring small capitalization stocks returns. Roll (1981) asserted that the riskiness of small capitalization stocks was underestimated because of the serial correlation linking their rate of returns. Such correlation is the result of the lower frequency according to which small firms stocks are traded in equities markets. For such reasons, fluctuations in their prices are less volatile, risk is underrated and the value of beta is much lower than for stocks representing a claim in larger firms' earnings. According to Roll's view, the SFE rather than being an anomaly of financial markets, was the reward investors who had bought equities of smaller firms deserved for the increased risk they had borne. Roll was convinced that the anomaly was not a result of inefficiencies in capital markets but instead in the pricing model according to which equities were valued because of its inability to include such risk factors in the computations of equities' returns. Reinganum (1981) instead was in agreement with what Roll asserted in 1981, but he added that even if betas for small capitalization stocks were undervalued, that wasn't enough to completely explain the effect on its entirety. He analyzed that small cap stocks returns not explained by incorrect evaluations of beta, were still higher than 20% over the period 1964-1978.

The superior returns ,earned by small-capitalization stocks , may in addition be due to biases that are difficult to eradicate and that are common in most of the equity returns databases such as the CRSP. In these regards Shumway and Warther (1999), proved that most of the SFE, relative to the NASDAQ was due to the delisting stocks process accomplished by scholars and researchers in order to eliminate all the poor performing stocks that could have modified the targeted results. In such a way the average returns for common stocks were upward biased as well as all related survey's results. Furthermore Shumway and Warther estimated that returns registered by the delisted stocks were -55% over the time period 1972-1995, on average. When the delisted stocks were included in the composition of a portfolio reflecting the NASDAQ in its integrity, no significant SFE was individuated over the same time period cited above. Anyways the same was not true for both the NYSE and the AMEX exchanges. In fact, once the delisted stocks were added back to the portfolio composed by all the stocks in the respective exchanges, a weakened SFE was still detectable.

In conclusion, it seems that a lot of authors and economist attempted to entirely relate the SFE to a statistical artifact . Even if a lot of empirical evidence had been reported during the last two centuries, it has appeared almost evident that statistical errors couldn’t’ t explain the whole part of the story. Statistical and evaluation biases were impossible to deny as well as the effectiveness of the anomaly once corrected for these errors. None of the previous cited researchers in fact, was able to completely deny the existence of the SFE.

3.3.2. Can the firm size be considered a proxy for risk?

Firm size may be an indicator of some macroeconomic factor that drives the variation in collected returns of a particular stock. It has been empirically showed that the small-capitalization stocks risk factor is much more sensitive to market fluctuations relative to the large-capitalization stocks one and it is for this specific reason that small firms earn return in excess of larger ones[71]. According to such analysis, that returns in excess does not constitute a market inefficiency or an anomaly but it is simply the reward investors who acquired small firms ' equities deserve for such increased risk bearing. Fama and French (1996), proposed a new asset pricing model, different from the CAPM. They constructed a three factor model that included factors representing the firm's size (Small Minus Big factor) and equity evaluation (High Minus Low[72]) in addition to the usual CAPM market factor. It seemed suddenly clear that the three factor model was much more functional than the CAPM alone. Fama and French argued that, in the evaluation of US stocks data from 1963 to 1991, most of the returns differential between stocks returns that the CAPM wasn't able to explain, was instead captured by the SMB and HML factors. The economists ' aim was the one of relating returns differentials to respective firms risk factors.

Firms' distress risk

Fama & French deduced that the SMB and HML factors they individuated, were good predictors of certain characteristics of firms such as profitability or distress[73] risk. Referring to the book-to-market parameter, small firms were individuated to earn on asset, in a minor measure with respect to bigger ones, in particular after 1981, year in which the effect was discovered for the first time. Fama and French indeed argued that the lower amount of earnings presented by small firms indicated a surprise to expected future profitability after the first years of the decay from 1980 to 1990.They concluded that the level of profitability reflected by the SMB factor could be the source of common risk they were searching for. Chan and Chen (1991) continued on the same path initiated by Fama and French, asserting that smaller firms involved a considerably higher amount of risk due to their intrinsic structure. Small firms were considered to be marginal, less productive and

[71] It is consistent with the empirical evidence provided in the paragraph 3.2.3. , especially for what concerns the survey relative to US.

[72] One of three factors in the Fama and French asset pricing model. HML accounts for the spread in returns between value and growth stocks. HML argues that companies with high book-to-market ratios (value stocks) outperform those with low ones (growth stocks).Also referred to as the "value premium"

[73] A condition where a company cannot meet or has difficulty paying off its financial obligations to its creditors. The chance of financial distress increases when a firm has high fixed costs, illiquid assets, or revenues that are sensitive to economic downturns.

efficient and consequently to reflect an augmented leverage ratio[74] that caused them to be more sensitive to negative economic circumstances in terms of cash flows. A lot of authors supported the view that the SFE reflected the above cited firms' characteristics. Chen and Zhang (1998), Vassalou and Xing (2004) provided some evidence in favor of this theory. In particular Vassalou and Xing conducted a survey on US stocks, analyzing data from 1971 to 1999 and inferred that the SFE was found to be statistically significant only for stocks belonging to the quintile of stocks showing the highest probability of default. They finally concluded that stocks returns were positively related to default risk and that the effectiveness of the SFE was strongly connected to such contingency.

Nevertheless most of subsequent authors discredited the hypothesis of a positive correlation between the SFE and distress risk. Dichev (1998), for example demonstrated that firms with higher probability of going bankrupt (a proxy for default or distress risk), not only didn't outperform bigger and financially solid firms but indeed underperformed them. On the same vein, in recent years, economists such as Campbell, Hilscher and Szilagyi (2008) showed that portfolios composed by stocks of distressed firms presented low average returns, high market betas and excessive loadings on the SMB and HML factors .All these findings seriously questioned the validity of the hypothesis formulated by Fama and French.

May the Small Firm Effect be caused by macroeconomic contingencies?

There exists a huge literature arguing that the SFE was mainly the evidence of the influence of macroeconomic factors related to both investment and consumption over small firms' equities. Particularly, Liew and Vassalou (2000) tested the correlation between the Fama and French's three factors and the future GDP growth for ten countries, over the period 1978-1996. Results were quite surprising: the SFE was found to reflect a lot of information about output growth, regardless of the market factor contribution. In a regression accounting for a lot of sensible variables, the SFE was still able to predict reliably future economic growth in at least six of the analyzed ten countries. On the same path, Zhang, Hopkins, Satchell and Schwob (2009) did not only trace the same positive relationship between output growth and the SFE previously discovered by Liew and Vassalou , but also found that the effect was negatively related to expected inflation[75]. According to their analysis,

[74] Companies rely on a mixture of owners' equity and debt to finance their operations. A leverage ratio is any one of several financial measurements that look at how much capital comes in the form of debt (loans), or assesses the ability of a company to meet financial obligations.

[75]Investor and public expectations of current or future inflation. These expectations may or may not be rational, but they may affecthow the market reacts to changes in target interest rates. For example, the market usually responds well to a cut in interest rates, butif investors expect inflation to go higher in the near future and the Federal

small cap stocks outperformed large cap ones, in particular when short term rates were low and the term spread high[76].

The authors tested the effect in different macroeconomic frameworks and tried to relate the variation in its effectiveness to changes in macroeconomic variables. Specifically, they measured the performance of the SFE both in absolute and in market-risk-adjusted terms. Their study enlightened that, in absolute terms, the effect seemed to be stronger in periods of economic expansion or when short term interest rates were decreasing, during falls in unexpected inflation and finally when credit terms and spreads were widened. Nevertheless, once accounted for market risk, the economists found the effect not to be statistically significant at all, even if differentials were still recorded. The only correlation coefficient that was found to be statistically significant was the one linking the degree of the anomaly intensity with the term spread. They concluded that the SFE was in somehow related to improvements or innovations in macroeconomic variables that would have lowered market risk and expanded the investment frontier. Zhang, Hopkins, Satchell and Schwob's findings are summarized in Table 3.3

Reserve cuts rates, the market may not react positively.

[76] The difference between yields on differing debt instruments, calculated by deducting the yield of one instrument from another. The higher the yield spread, the greater the difference between the yields offered by each instrument. The spread can be measured between debt instruments of differing maturities, credit ratings and risk.

Small minus Big factor ' s performance under various economic regimes

Table 3.3

SMB's performance under different economic regimes

Macro Indicator	Description	Time Period	State of Economy	SMB's Performance Absolute	SMB's Performance Market Risk-Adjusted (CAPM Alpha)
NBER Recessions	1 if recession as defined by NBER; 0 otherwise	1927-2011	Expansions	3,8%	1,5%
			Recessions	-0,4%	1,0%
			Difference	4,2%	0,5%
			t-stat	4,60	0,18
"Surprise" in next quarter GDP growth	Next quarter annualized real GDP growth minus average GDP growth in last 4 quarters	1948-2011	Positive	3,7%	0,5%
			Negative	0,9%	0,1%
			Difference	2,8%	0,4%
			t-stat	2,16	0,46
Unexpected inflation	Realized monthly inflation minus expected inflation as proxied by the difference between the current T-Bill rate and its 12 month moving average (Fama & Gibbons, 1984)	1948-2011	Positive	2,1%	1,1%
			Negative	6,5%	3,0%
			Difference	-4,5%	-1,9%
			t-stat	-3,68	-0,43
Risk free rate	3-month T-Bill rate; high if current rate greater than 5-year moving average; low otherwise	1938-2011	High	1,5%	0,3%
			Low	4,2%	2,0%
			Difference	-2,8%	-1,7%
			t-stat	-4,07	-0,76
Term spread	Difference between the 10-year and 3-month Treasury rates; high if current spread higher than 3-year moving average; low otherwise	1956-2011	High	7,5%	5,7%
			Low	-1,4%	-2,0%
			Difference	8,8%	7,7%
			t-stat	10,99	2,90
Credit spread	Difference between Moody's Baa Corporate Bond Index yield and 10-year Treasury rate; high if current spread higher than 3-year moving average; low otherwise	1956-2011	High	5,1%	3,4%
			Low	0,6%	0,0%
			Difference	4,5%	3,5%
			t-stat	5,58	1,30

Source: Kenneth French Data Library; FRED; FactSet; NBIM calculations; Zhang, Hopkins, Satchell and Schwob (2009)

Source:Kenneth French Data Library;FRED;FactSet,NBIM calculations;Zhang,Hopkins,Satchell,Schwob(2009)

What about liquidity risk?

A vast literature sustains that the SFE may be explained by the Liquidity Effect, at least partially. In the specific, Amihud and Mendelson (1986) studied the returns ' behavior of stocks from 1961 to 1980, tracing a strictly positive relationship between average portfolio-risk-adjusted returns and their bid-ask spread[77]. Furthermore, they observed that the slope of the line regressing

[77] The amount by which the ask price exceeds the bid. This is essentially the difference in price between the highest price that a buyer is willing to pay for an asset and the lowest price for which a seller is willing to sell it.

stocks returns over their spreads, decreased along with the spread. The most indicative information, was that once the firms' size was included as a variable in the regression model, the spread effect was still present, hence the main conclusion the two economists inferred was that , at least partially, the SFE was justified by liquidity effects. Recently, Amihud (2002), conducted a survey to verify the correctness of his previous findings. The research covered stocks of the NYSE from 1964 to 1997. He measured liquidity as the average, over a pre-specified period, of the ratios of a stock's daily return with respect to its daily monetary volume. He demonstrated that illiquid stocks were those which reflected superior ex ante returns and since the small cap stocks are always less frequently traded, he concluded that the SFE was indeed representative of an illiquidity premium.

The neglected firm risk

The fact that less frequently traded and small capitalization stocks are those on which investors usually have a minor amount of information, should be pretty straightforward. Investing in smaller firms may be risky for different reasons. First of all, authorities are less concerned with such entities and both managers and insiders may take advantage from it by appropriating what is due to shareholders without being detected. Secondly, there could be difficulties in the evaluation of the firm because of the lack of enough information. As argued in the previous chapter, less covered stocks were found to earn superior returns with respect to stocks of well known and acknowledged companies. Carvell and Strebel (1987), argued that the effect was much more prominent for small firms and that the SFE may be considered a valid proxy for the Neglected Firm Effect (NFE). Nevertheless, recent researches conducted by Brennan, Chorida and Subrahmanyam (1997) and, Beard and Sias (1997) weakened the robustness of the NFE hypothesis and in particular its positive relationship with the Small Firm anomaly. They found no statistically significant evidence of the NFE over the periods 1978-1989 and 1982-1995 respectively.

In conclusion, all of the variables that accounts for risk, analyzed in this paragraph were able to explain the persistence of the effect over a specific time period.

In particular, the liquidity factor seemed to be the most promising and reliable one. Anyways none of them was able to explain the variation of the anomaly over time and all its seasonality patterns.

3.3.3. Behavioral Finance

Recently, an increasing number of authors started to discredit both the literature according to which the SFE was simply caused by statistical estimation errors and the literature asserting that superior returns earned by small capitalization stocks were the reward for the greater risk involved in small, less renowned companies. Such authors were convinced that investors were not fully rationale whenever transacting in financial markets. Hence pricing anomalies and market inefficiencies arose. The main connection between the SFE and Behavioral Finance was, for the first time, individuated by De Bondt and Thaler (1985). They were convinced that investors tended to overreact to unexpected earnings announcements and such behavior made the "stock price walk", to some extents, predictable. Furthermore they found that subsequently to an earnings announcement, stocks that performed particularly well in the past (prior winners) were outperformed by stocks that poorly performed in the past (prior losers) in the following period. To attain such knowledge the two authors analyzed the behavior of two portfolios, one composed by prior "winners" and one by prior "losers". In addition, once realized that small capitalization stocks tended to be prior losers while large capitalization stocks prior winners, they argued that the SFE may simply represent a market correction mechanism to the Overreaction Effect (a market anomaly the two authors widely debated, their findings about it are reported in the second chapter). Another similarity resides in the fact that the Overreaction Effect was found to be more pronounced in January ,as well as the SFE.

On the same vein, Lemmon & Portniaguina (2006) found a negative relationship between investors' sentiment or attitude and the variation in excess returns of small capitalization stocks, since 1977. As long as investors' confidence increases, once adjusted for some macroeconomic variables such as business cycle[78] and the like, returns on small capitalization stocks decreases. When investors are too much optimistic, they tend to overvalue small capitalization stocks and to undervalue them when instead they're pessimistic. The sentimental influence acquires a huge importance in small capitalization stocks performances because ,most of the times, shares of small firms are held by individual investors that are obviously more emotional than financial institutions. However, the two authors found no statistically significant evidence of such sentimental influence before the 1977 and didn't succeed in finding a reason why the effect weakened after 1981.

[78] The fluctuations in economic activity that an economy experiences over a period of time. A business cycle is basically defined in terms of periods of expansion or recession. During expansions, the economy is growing in real terms (i.e. excluding inflation), as evidenced by increases in indicators like employment, industrial production, sales and personal incomes. During recessions, the economy is contracting, as measured by decreases in the above indicators. Expansion is measured from the trough (or bottom) of the previous business cycle to the peak of the current cycle, while recession is measured from the peak to the trough. In the United States, the National Bureau of Economic Research (NBER) determines the official dates for business cycles.

3.3.4. An alternative justification for the Small Firm Effect

All over this thesis, a lot of empirical evidence about the Small Firm anomaly has been provided. Specifically, it has been widely shown that most of the times ,portfolios composed by smaller capitalization stocks, tended to outperform portfolios composed instead by large capitalization ones, especially before the 1981, year in which the effect was discovered . Consequently, I reasonably evaluated that providing with an additional survey, aimed at verifying the robustness of the phenomenon, would not be neither innovative nor useful at all. What could be surprising, to some extents, is the interpretation Ivan Lustig and Philip Leinbach (1983), attributed to such evidence. The two scholars, analyzed the conduct of stocks listed on the NYSE from 1931 to 1979. The data they studied were obtained from the University of Chicago's center for research in securities prices. In order to deeply investigate the stocks' price patterns, they decided to subdivide the time horizon into nine five-years periods and one four-year period (1976-1979) . Two portfolios were constructed for each time period and in a more specific way, one top portfolio, consisted of the upper quintile of all stocks traded in the NYSE ranked by market capitalization and one bottom portfolio composed by all those stocks lying in the lowest quintile. The average number of stocks composing each portfolio for each time period is reported in Table 3.4:

Average Portfolios composition over each of the ten time-periods (1976-1979)

Table 3.4

Risk and Return of Top and Bottom Portfolios

	Top Portfolio		*Bottom Portfolio*	
Year	*Average Beta*	*CAR*	*Average Beta*	*CAR*
1931–35	1.0830	34.5%	1.8126	296.0%
1936–40	1.4548	−3.3	1.7597	30.8
1941–45	1.0370	7.1	1.8915	137.3
1946–50	1.0220	1.8	1.9897	−60.1
1951–55	1.0187	−9.5	1.3965	−64.4
1956–60	0.9694	3.3	0.7936	2.6
1961–65	0.9360	3.3	0.8405	37.2
1966–70	1.0069	3.0	1.0944	35.5
1971–75	0.9896	13.4	1.3062	18.9
1976–79	1.0423	−4.3	1.2222	94.1

Source: Financial Analysts Journal ,May/June 1983, Volume 39 Issue 3

Adopting the Sharpe-Lintner Capital Asset Pricing Model as a benchmark, the authors computed the differentials in portfolios returns for each of the ten time periods, with respect to the returns predicted by the model. Specifically, they computed the Cumulative Abnormal Returns , defined as the sum of all registered abnormal returns, where in turn abnormal returns were considered to be the difference between actual returns earned by the securities and their expected

returns instead. The results they achieved are summarized below:

Cumulative Abnormal Returns of top and bottom portfolios(1976-1979)

Table 3.5

	Average Number of Stocks in Each Five-Year Portfolio	
Year	*Top Portfolio*	*Bottom Portfolio*
1931–35	34.0	18.0
1936–40	118.0	38.1
1941–45	135.6	38.0
1946–50	142.2	60.0
1951–55	156.8	72.8
1956–60	184.1	71.9
1961–65	189.8	61.0
1966–70	202.9	52.3
1971–75	213.9	52.1
1976–79	323.3	56.2

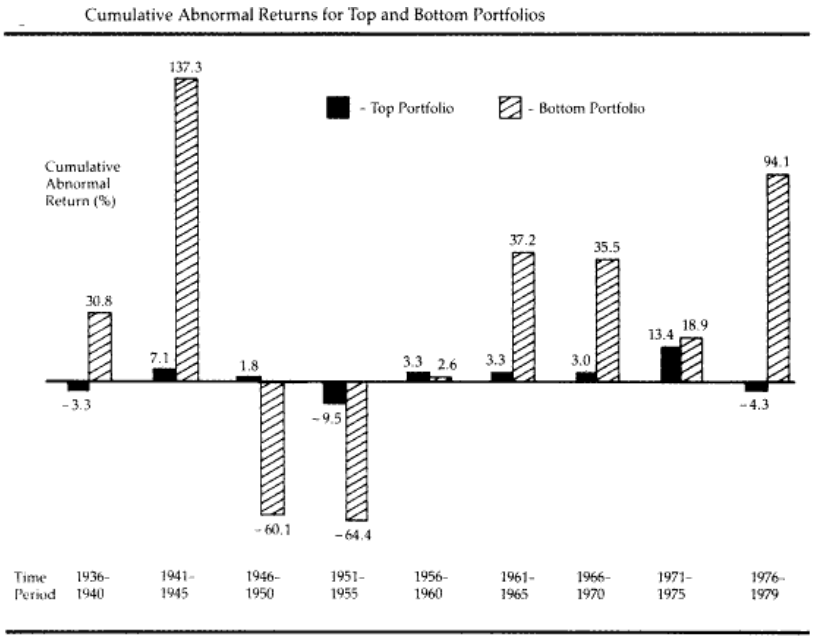
Source: Financial Analysts Journal **,**May/June 1983, Volume 39 Issue 3

The first value that appears noteworthy is the CAR[79] value for both the top and the bottom portfolios, detected for the period 1931-1935. Anyways, since the number of stocks composing both portfolios was not considerably high, Lustig and Leinbach concluded that those values of the CAR parameter were simply the result of a sampling bias, merely outliers. For this specific reason, they concentrated their attention to the analysis of the results obtained for following periods. In addition, to improve the validity of their survey, they performed the computations of the CAR according to risk-adjusted measures and they also tested whether the average portfolio's beta was in some way correlated to portfolio's CAR aiming at confirming the irrelevance of whatever firm risk-factor over its actual return. Results were encouraging: the correlation coefficient between the average beta and CAR was found to be only 0.11 for the period 1936-1979 and -0.13 for the period 1951-1979 . As illustrated by the Figure 3.9, in six out of the nine periods taken under consideration, the CARs earned by the bottom portfolios were significantly higher than the CARs of the bottom ones. Despite some conceivable exceptions, small capitalization stocks were found to outperform large ones.

[79] CAR stands for Cumulative Average Return. A portfolio's abnormal return (AR) at each time is AR_t=Sum from i=1 to N of each ar_{it}/N. Here ar_{it} is the abnormal return at time t of security i.Over a window from t=1 to T, the CAR is the sum of all the ARs.

Cumulative Abnormal Returns comparison between top and bottom portfolios

Figure 3.9



Source: Financial Analysts Journal **,**May/June 1983, Volume 39 Issue 3

Their analysis evidenced that abnormal returns of large capitalization stocks were zero at the 95% confidence level, while abnormal returns earned by small-cap stocks were higher than abnormal returns earned by large ones at the 90% confidence level. Quite an impressive and clear result.

Lustig and Leinbach performed such analysis for two specific reasons: to test a particular trading strategy based on market inefficiency and to question the validity of the Capital Asset Pricing Model. They argued that one of the greatest difficulties encountered by the Sharpe and Lintner' s pricing model was the basic and necessary assumption that all financial investors were endowed with the same knowledge of the market. However, information regarding firms' financial solidity is not always that easy to be obtained. Companies such as IBM[80] or AT&T[81] were giants in financial markets and their sensitive information and policies are much more widely debated and reported in the news. Small firms instead, were not covered in the same way. The innovative and alternative interpretation of the SFE provided by Lustig and Leinbach was that abnormal returns of

[80] The International Business Machines Corporation (IBM) is an American multinational technology and consulting corporation, with headquarters in Armonk, New York. IBM manufactures and markets computer hardware and software, and offers infrastructure,hosting and consulting services in areas ranging from mainframe computers to nanotechnology

[81] AT&T Inc. is an American multinational telecommunications corporation, headquartered at Whitacre Tower in downtown Dallas,Texas. AT&T is the second largest provider of mobile telephone and the largest provider of fixed telephone in the United States, and also provides broadband subscription television services.

bottom portfolios reflected the compensation investors deserved for having strongly engaged in finding relevant information. According to them, if the CAPM would have included as a valuation parameter the opportunity cost of acquiring information, the bottom portfolios abnormal returns would have disappeared. Indeed, they argued the inadequacy of the CAPM in predicting the behavior of small capitalization stocks, while the model seemed to appropriately predict returns of large ones. The main reason for which the model almost correctly predicted the returns for larger companies analyzed in the survey was that the two authors assumed the market as the sum of the market value weighted returns of each stock of the NYSE. Since large stocks accounted for the great majority of the value of the entire stock market, the computed beta essentially represented a regression of the returns of large stocks against itself in the form of market returns. Given such inference, it should be now clear why the CAPM was a good predictor of large-cap stocks returns only.

Basing their argumentations on such findings, Lustig and Leinbach concluded that the CAPM ,due to its inability of accurately forecast returns of small-cap stocks, was misleading and that the SFE was not a symptom of a market failure but instead of a CAPM failure. Hence investing in smaller stocks wasn't more profitable than investing in larger ones, once information searching and opportunity costs are taken into account.

Conclusions

While the first chapter of this thesis profusely discussed the Market Efficiency Theory along with the empirical evidence sustaining it, both the second and the third ones aimed at enumerating and analyzing all its flaws. In order to do this, in the second chapter, five anomalies typically recurring in financial markets have been presented, except for the Small Firm Effect to which the entire third chapter was dedicated. All of them had systematically occurred at least until the first half of the twentieth century and as it can be easily noticed by reading the dissertation, each of them has been proved and empirically documented. In addition, no author was able to relate such anomalies to something different from market inefficiencies. The anomalies that have been discussed in the second chapter, are the following: The January Effect, Market Overreaction, Excessive Volatility, Mean Reversion and the Neglected Firm Effect:

1. More specifically, authors such as Rozeff, Kinney, Donald Keim (1983) and Reinganum (1983), through a detailed analysis of stocks being traded in the NYSE, found that in January, returns were considerably higher than in any other month of the year. Some authors argued that such phenomenon occurred because of the fiscal pressure on investors, who aiming at realizing capital losses for tax purposes in the latter months of the year, sell poorly performing shares. Once the new year started, the lack of selling pressure drove up the price of the previously considered securities, giving rise to the anomaly. Anyways, it was found not to be the whole part of the story, since Kato and Schallheim (1985) and McConnell and Schlarbhaum (1984) found evidence of the January Effect in countries adopting different fiscal years.

2. Scholars like Keynes, Kahneman, Tversky, Russel and finally Thaler, instead , concentrated their focus on a different issue : the Market Overreaction phenomenon .Keynes in particular asserted : *“ day to day fluctuations in the profits of existing investments,which are obviously of an ephimeral and non significant character, tend to have an altogether, excessive, and even absurd, influence on the market”*(Keynes,1938,p.138). Such anomaly was related to a great variety of market failures, but in particular Shiller (1981) argued that the overreaction's principle could be an explanation to the fact that when long-term interest rates are higher than short-term ones, they suddenly start to move down.

3. Strongly related to the Market Overreaction phenomenon, Market Excess Volatility engaged many scholars in analyzing and verifying the causes of such deviation from market efficiency prescriptions. LeRoy and Porter (1981) and Shiller (1981) again collected and accurately transcribed the experiential evidence provided by the anomaly, while La Civita

along with Le Roy (1981), proposed an innovative explanation for the phenomenon structured on the principles of Behavioral Finance and of risk neutrality.

4. The Mean Reversion Effect, instead, is known as the phenomenon according to which stocks prices and returns eventually move back towards the mean or average. Kanhema and Tversky (1973) attributed it to three well defined people erroneous behaviors, namely: the availability bias, the aversion to losses and the affinity for lower prices. Fama and French (1998) too , dedicated their time in studying the phenomenon and concluded that the effect was stronger in the very short run, while it was recorded to be almost insignificant when the investment horizon was increased to eight years. Furthermore, in accordance to Poterba and Summer's (1988) findings, Fama and French argued the accentuated effectiveness of the anomaly for equities of smaller firms.

5. The last topic, the second chapter investigated, was the Neglected Firm Effect, the anomaly according to which securities often ignored by analysts, usually offer strictly higher returns than well known securities. One of the most comprehensive and exhaustive research regarding such market inefficiency was conducted by Steven A. Carvell (1987). His survey, analyzed the conduct of 865 stocks prices obtained by a cross comparison between two data sources, the IBES (Institutional Broker Estimate Survey) and the CRSP, that is the Center for Research in Security Prices. His primary goal was to check whether the Neglected Firm Effect was an autonomous phenomenon, free from dependencies from others effects like the January and the Small Firm ones. Empirical evidence seemed to confirm the autonomy and the statistical significance of the phenomenon even once corrections for size and seasonalities were been made.

The entire third chapter finally focused on a deep analysis of the Small Firm Effect, the main object of interest of this thesis. The first economist who discovered and documented the Size Effect was Banz (1981). Since the publication of his famous paper "The relationship between return and market value of common stocks" (1981) , a lot of authors have discussed and examined the validity of the effect across different equities markets and different periods in time, proposing different explanations to small firms outperformance with respect to larger ones.

Even though the Small Firm Effect had showed itself to be always sizeable in US in the long run, it presented itself to be continually varying .It assumed different intensities over time. Some authors, in fact, claimed that it suddenly disappeared after its discovery in 1981, but recent evidence enlightened the persistence of the anomaly even in last decades, suggesting that the Small Firm Effect may still constitute stable ground for a profitable trading strategy over the long-run.

Anyways because of the illiquidity and the trade difficulties of the corresponding equities, investors may not be entirely compensated by the Small Firm premium, since holding and trying to sell such equities could be found costly. Moreover in the small-capitalization stocks' universe, the Small Firm Effect showed itself to be more effective for value stocks.

The assumption that the SFE is representative of a sort of risk premium is still under debate. In the previous pages, some empirical evidence supporting such hypothesis has been provided. Nevertheless, some economists and scholars would not strictly relate the firm size to the risk premium. According to some of them, size constitutes a proxy for some other risk factors related to the firm's size, such as the default, bankruptcy or distress risk. Links between firms' size and macroeconomic factors have been traced as well. However, none of such links had been found to be strong or persistent. An alternative theory views the lower liquidity of small-capitalization stocks as an element strongly contributing to the higher risk they involve. The increase in liquidity in the small-capitalization equity market during the 1980s seemed to justify the decrease of the effectiveness of the SFE started from 1981.

Finally, more than the efficiency level of capital markets, the adequacy of the asset pricing model was questioned. A specific study, performed by Lustig and Leinbach (1983), was reported to demonstrate that the CAPM is not fully able to predict equities' returns. Due to its construction features, the model seems to properly predict returns of large-cap firms, while differentials between predictions and actual returns of small-cap equities were significantly substantial. The authors argued the inability of the model in including within it, information and searching costs that are surely higher for investors acquiring small cap stocks. They concluded that once corrected for such biases, there would be no differentials between returns of small and large cap stocks.

The overall dissertation aimed at evidencing the enormous gap lying between the Market Efficiency Theory's prescriptions and empirical evidence. One of the main conclusions to be inferred is that classical models work as poor predictors of stocks' prices fluctuations or reactions. An incredible variety of influencing factors affect financial markets' behavior in such a way to give birth to numerous anomalies. One of them, the Small Firm Effect, intrigued me the most. As previously documented, the intensity of whatever anomaly (the SFE included) gradually decreased over time for a couple of reasons. Firstly, once such anomalies had been discovered, investors willing to exploit them to make a riskless profit (arbitrageurs) contributed to their disappearance. Secondly, the continuous improvements in the communication and technology sectors are making financial markets always more and more efficient. Nowadays it is impossible that the same security is differently priced in different countries since prices are instantly and constantly updated thanks to

connected computer systems and as a consequence trading strategies focused on exploiting price differentials are quite unfeasible. As partially suggested by the Adaptive Market Hypothesis, the degree of efficiency of financial markets is substantially increasing over time through a process of evolution based on technological improvements.

Nevertheless, one of the main drivers of anomalies in financial markets remains the irrational behaviors market participants adopt whenever transacting. If, on one hand, inefficiencies due to the market structure may be ameliorated by technological progress, on the other hand, irrational expectations and behaviors of investors are difficult to eradicate. In this regards, Behavioral Finance acquires a fundamental explanatory power but fails in providing with solutions or future perspectives. The Adaptive Market Hypothesis, instead, tries to fulfill the purpose, providing with explanations that, according to my opinion, appear implausible.

The diminishing intensity of the Small Firm Effect over time is a clear evidence of the arguments discussed in the above paragraphs. Indeed, the survey I personally conducted (section 3.2.3.) resulted in a statistically insignificant negative SFE for the London Stock Exchange over the period 2005-2014, while it resulted in a weakly positive SFE for the NYSE in the same years. Anyway, implementing a profitable trading strategy trying to take advantage of the SFE appears too much costly, in terms of information searching costs, compared to the expected returns differential offered by stocks of small firms with respect to large ones.

As a last point the individuation of a reliable pricing model, able to consider both opportunity and information searching costs for the computations of overall returns, would contribute further to the progressive elimination of any market anomaly.

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