# VALIDATING THE CAPITAL ASSET PRICING MODEL AT IRISH STOCK EXCHANGE

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## Abstract

The Capital Asset Pricing Model (CAPM) is one of the most popular application in finance since its development in the late ‘60s; it assumes that only one factor, the systematic risk, identified by the Greek letter beta, influences the required return on assets and that the relationship is positive and linear. Nowadays, it is still a discussed area in academic literature, especially for its idealistic assumptions, which are rejected by several empirical tests.

This study investigates the efficiency and the validity of the Capital Asset Pricing Model, at Irish Stock Exchange (ISE), for a sample of 25 companies, selected from the ISE database, during the period 2001-2011, which has been divided into three sub-periods, in order to examine the model pre, during and after the global financial crisis which occurred in 2007-2008.

The companies are then grouped in 110 semi-annually portfolios, of 5 stocks each, in descending order of beta. The methodology pursued, with the aim to clarify the linearity and positivity of the risk-return relationship, consists of a linear regression followed by a t-test of the intercept which showed a rejection of the model in all the three sub-periods, as the intercept was non-zero. However, despite the statistically non-significance of the CAPM, it emerged that during the crisis the co-movement risk-return is more evident and positive than in the other sub-periods (pre and post-crisis). Hence, the results suggest that there is more than one factor which explains the asset returns, and that the Capital Asset Pricing Model, itself is not a valid model in helping to predict the asset prices at Irish Stock Exchange.

The outcome of the study can be seen as a stimulus for further researches in this field, given the poor academic attention at the Capital Asset Pricing Model, in the Irish context and during the global financial crisis.

Keywords: Capital Asset Pricing Model, Irish Stock Exchange, Risk-Return Relationship, Linear-Regression, Global Financial Crisis.

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## List of Abbreviations

Abbey Plc **– (DOY)**

Allied Irish Banks Plc **– (AIB1)**

Aminex Plc **– (DPO)**

Atlantic Security Market **– (ASM)**

Bank of Ireland Group Plc **– (BIRG)**

Capital Asset Pricing Model **– (CAPM)**

Consumption Capital Asset Pricing Model **– (CCAPM)**

CPL Resources Plc **– (DQ5)**

CRH Plc **– (CRG)**

Datalex Plc **– (DLE)**

Dhaka Stock Exchange **– (DSE)**

Diageo Plc **– (GUI)**

Donegal Investment Plc **– (DQ7)**

Efficient Market Hypothesis – (**EMH)**

Enterprise Security Market **– (ESM)**

FBD Holdings Plc **– (EG7)**

Fully Modified Ordinary Least Squares – (**FMOLS)**

Glanbia Plc **– (GL9)**

IFG Group Plc **– (IJG)**

Independent News & Media Plc **– (IPDC)**

Intertemporal Capital Asset Price – (**ICAPM)**

Irish Continental Group Plc **– (IR5B)**

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Ormonde Mining Plc **– (ORQ)**

Ovoca Gold Plc **– (OVXA)**

Paddy Power Betfair Plc **– (PPB)**

Permanent TSB Group Holdings Plc **– (IL0A)**

Providence Resources Plc **– (PZQA)**

Ryanair Holdings Plc **– (RY4C)**

Tesco Plc **– (TCO)**

## Introduction

The Capital Asset Pricing Model, developed by Sharpe (1964), Lintner (1965) and Mossin (1966), signs the origin of the Asset Pricing Theory, and it is known as one of the "*major contributions of academic research in the post-war era*" (Jagannathan and Wang, 1996, p. 4). After more than 50 years it is still applied in finance for portfolio evaluations and for estimations of the cost of capital (Graham and Harvey, 2001), despite the criticisms arose by several empirical tests.

The CAPM owes its popularity and broad use to the absence of alternatives capable to produce the same outcome to the model, albeit Sharpe (1964) recognised that the Capital Asset Pricing was characterised by highly limitative assumptions.

The model is defined as an equilibrium theory of risk and return on assets and, more specifically, it states that the required return on assets is only explained by the systematic risk, beta. Furthermore, the required return on asset is a premium added to the risk-free rate for compensating the whole risk borne by the potential investors (Srinivasan, 1988).

The criticism around the CAPM is due to its unrealistic assumptions as they simplify the financial world in an "idealistic" framework where investors are risk-averse and price-takers, all the information are available to all investors and there are no market imperfections (taxes, restriction on short-selling, regulations, etc.), risk-free assets permit the borrowing and lending of unlimited amounts, all the assets are divisible and marketable. Moreover, it assumes that the risk has to be assessed in relation to the market portfolio, which is difficult, in real life, to test properly, due to limitation of the proxies chosen (Roll, 1977; Fama and French, 2004); in fact, a market portfolio should comprehend other categories of assets rather than just common stocks (bonds, consumer durables, real estate, human capital, etc.), but the validation of the CAPM is limited to a single and narrow group of asset (stocks).

Numerous attempt have been made by researchers, over the years, as a remedy against the theoretical shortcomings of the model: Jensen, Black and Scholes (1972)

test the CAPM under two factors; Merton (1973) analyses the Intertemporal Capital Asset Price (ICAPM), where investors are interested not only in investing in the market but to consume and reinvest their wealth that changes through time; Fama and French (1992,1996) introduced a multi-factor model, denying the dependence of the returns on the systematic risk only; Jagannathan and Wang (1996) confirm the validity of the CAPM when it is applied a conditional form; Pettengill et al. (1995) introduce a model that considers bullish and bearish market conditions.

Other findings (Basu and Chawla, 2010; Lee, Chang and Chong, 2016; Obrimah, Alabi and Ugo-Harry, 2015) highlight a different performance of the model when it is applied in emerging markets (India, Malaysia, Nigeria), rather than developed countries, albeit there is no homogeneous consensus about its validity.

However, despite the large empirical evidence and efforts over time to improve the Capital Asset Pricing Model, by introducing or relaxing assumptions, little attention has been paid to its efficiency to predict the asset pricing, and in particular, its efficiency within the Irish market.

The study addresses the issue of the risk-return relationship, which, according to the theory of the model, should be positive and linear, as the systematic risk should be the only factor that affects the asset returns; the objective is, thus, to look at the model in a positivistic way and to validate it only if the mentioned relationship is positive and linear and the required return on asset is exhaustively explained by beta, the systematic risk.

The methodology applied follows the studies of Fama and MacBeth (1973); Basu and Chawla (2010); Hwang, Gao and Owen (2012); Lee, Cheng and Chong (2016), who examine the CAPM looking at the single relationship risk-return, rather than expanding it to a multi-factors model.

In particular, the analysis focus on a simple framework of linear regression and t-test of stocks traded at Irish Stock Exchange, during a period of time of 11 years, from 2001 to 2011, which are divided into 3 sub-periods, in order to observe the CAPM pre, during and post-financial crisis which occurred in 2007-2008.

The analysis developed has the purpose to give information about the validity of the CAPM in the Irish context, understanding, at the same time, the influence of the crisis in determining the asset prices.

# Chapter 1. Literature Review

The Capital Asset Pricing Model (CAPM) is considered, for more than 50 years, a gauge in modern finance in determining the returns of an asset. The following chapter examines the literature review related to the model, taking into account its evolution and the empirical results which brought many researches to refuse or accept its validity.

CAPM is still today object of studies, however it seems there is little evidence in testing the model in a positivistic way, that is studying the relationship between risk and return, which should be linear and positive and the systematic risk should be only explained by the parameter beta, β. Furthermore, the validation of the model is made by observing three periods of time: pre, during and post-crisis, which occurred in 2007-2008; the purpose of the study is to understand the effect of the recent financial collapse on CAPM, which is an issue that is not broadly discussed in literature.

The chapter has been structured in four sections: section 1.1 will commence with a discussion of the theoretical underpinnings of the CAPM, considering the Mean-Variance Efficient Portfolio Theory (Markowitz, 1952) as the foundation of the model, furthermore, in examining the assumptions underlying the model will be considered the efficient frontier in terms of investment opportunities; section 1.2 will critically analyse the evolution of the CAPM and the several versions of the model which propose a relaxation of the assumptions, judged incompatible within the real world; section 1.3 will discuss about empirical evidences across the world (emerging and developed countries); section 1.4 will introduce the purpose of the study by defining the research question.

## 1.1 The Capital Asset Pricing Model

In the 1950s the concept of Finance was revolutionized through Markowitz's (1952; 1959) Portfolio Theory, also known as Mean-Variance Efficient Portfolio Theory. Investors, risk averse by nature, according to this theory should look at

diversification of portfolios, rather than selection of investments by predicting the most profitable security. The mitigation of risk in the theory of portfolio choice occurs by diversification: it focuses on the efficient selection of the portfolios by the mean-variance analysis, which consist in maximisation of expected return, measured by the mean, given a certain level of risk, and minimization of risk, measured by variance, given a certain level of expected return.

Over the last 50 years' large attention has been paid to the impact of risk in financial transactions and how it can affect the prediction of capital asset prices in condition of uncertainty, where the investor's rational decision and the capital market behaviour are altered (Lintner, 1965).

During 1960s, Sharpe (1964), Lintner (1965), Mossin (1966) derived the Capital Asset Pricing Model (CAPM) affirming that the process of price determination is characterized by a risk premium and that the price itself is adjusted in relation to it. The model states that the relationship between the risk, expressed by β, the systematic risk of any specific asset, and the expected returns is positive and linear. The CAPM is rooted within the Markowitz's (1952) model with the purpose of estimating the relationship between risk and expected return that gives an efficient portfolio if the market of all assets is mirrored by asset prices (Fama and French, 2004). It is based on the following assumptions as set out by: Black (1972); Copeland et al. (2005); Shih et al. (2014); Blitz et al. (2014):

- The market is characterized by no constraints on short-selling and on borrowing.
- The market is frictionless and information are costless and available to all investors.
- The market is perfect: it is characterized by no taxes, no regulations, no restrictions.
- The quantity of assets is fixed, marketable and perfectly divisible.
- Investors are risk averse and rational: their behaviour is focused on maximizing the expected return given a certain level of risk, that is the expected utility of their absolute wealth.
- Investors are "price takers", they cannot influence the asset prices through their decision making.

- Investors can borrow and lend for unlimited amounts at a risk-free rate.
- The model considers only one period of time; however, it does not specify the length of the period. When it is considered an infinitesimal period, the assets follow a lognormal distribution rather than approximating to a normal one (Black, 1972).

Under the above mentioned assumptions, the model can be expressed as:

$$\mathbf{E(R_i) = R_f + \beta_i [E(R_m) - R_f]}$$

Where the symbols are defined as follows:

- **$E(R_i)$** represents the expected return on the assets given by the change in price of the assets: **$(p_1 - p_0) / p_0$**;
- **$R_f$** represents the risk-free rate;
- **$\beta_i$** is the systematic risk of the related asset, i, and it is the slope of the relation between the return on the assets and the return on the market. The slope coefficient can also be expressed as the quotient of the covariance of return on the assets and return on the market and the variance of the return on the market: **$\beta_i = Cov (R_i, R_m) / Var (R_m)$**;
- **$E(R_m)$** represents the expected return on the market Portfolio of all the assets in the market.

The model expands the Portfolio theory through the assumptions that is considered only one period at which individuals can invest and that investment are made by borrowing and lending unlimited amount of money at a risk-free rate. In this scenario, the efficient frontier of all possible investment is given by the curve above the point *b* in Figure 1 below; all the investment under the point *b* are inefficient and undesirable as the risk, represented by the x-axis grows given a lower related return, represented by the y-axis.

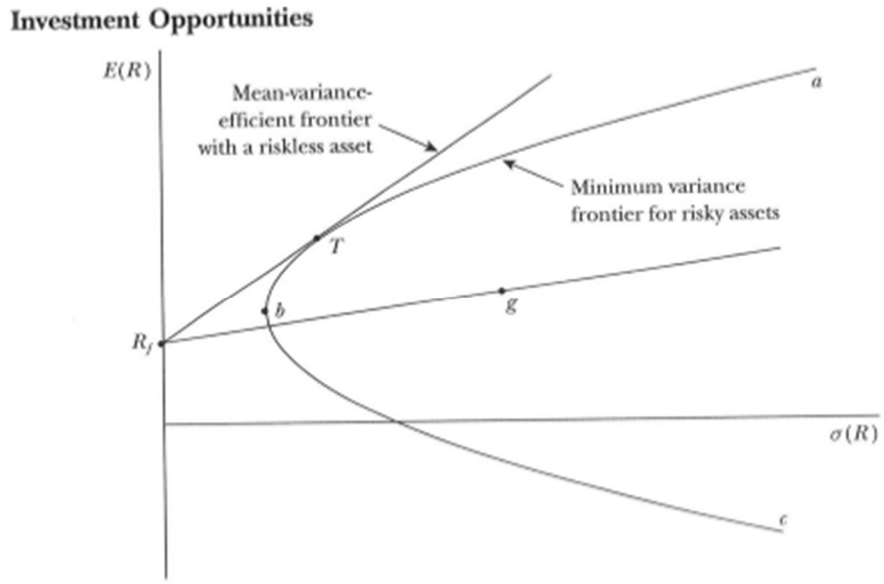


**Figure 1: Investment Opportunities. Fama and French (2004).**

Introducing the risk-free borrowing and lending the set of investment opportunities becomes a straight line where the efficient portfolio is the tangency portfolio *T* (Separation Theorem - Tobin, 1958) and the segment $R_f$ - *g* is the combination of risk-free lending.

The assumptions on which the CAPM relies belong to a hypothetic and perfect world; Cai, Clacher and Keasey (2013) find that the comprehension of the market is limited by the assumption that humans are rational and so the market itself. Indeed, its limitations have been broadly criticised in literature by many researchers who attempted to develop more realistic models which will be analysed in the following section.

### 1.2 The Evolution of CAPM

The assumptions of the model, as developed by Sharpe (1964), Lintner (1965), Mossin (1966), are related to a hypothetical and perfect market which is not compatible with the real world. Several studies attempted to relax or modify the assumptions of the CAPM, in order to create a more realistic model.

Mullins (1982) criticises the model by identifying some issues related to its real application: the CAPM could be inappropriate for the behaviour of financial

markets, because its assumptions do not match the reality; beta, the systematic risk, the risk-free rate and the expected return on the market represent a source of error when they are estimated through historical data, as they tend to be unstable over time, however it is arguable that, to analyse the behaviour of capital assets, historical data can be used as a prediction of the future, keeping in mind the distortions that arise from the proceedings, that is the methodology pursued in this study and at the same time its limitation. Other issues arise in corporate finance when CAPM deals with real assets in terms of capital budgeting decisions.

The main problem with testing the CAPM is that there is large evidence of the influence of other factors on asset returns, as the only systematic risk, beta, is not sufficient: Fama and French (1992, 1996, 2004) invalidate the CAPM referring to it as a model difficult to test as it mirrors "theoretical failures" that reflect its unrealistic assumptions; furthermore, they develop a three-factor model receiving Sharpe's (1998) acceptance, during an interview: "*I'd be the last to argue that only one factor drives market correlation. There are not as many factors as some people think, but there's certainly more than one*".

The multi-factors model explains the anomalies of CAPM by identifying three factors which explain the expected return on a portfolio in excess of the risk-free rate through (Fama and French, 1996):

- the difference between the return on the market and the risk-free rate (excess return on a broad market portfolio);
- the size effect of the stocks represented by the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks;
- the difference between the return on a portfolio of high-book-to-market stocks and the return on a portfolio of low-book-to-market stocks.

A multi-factor model could be taken in consideration for further researches, as the following study focus on testing the original CAPM as there is no support, for the Irish market of the validity of the model.

The CAPM, in its original form, seems theoretically incomplete as it does not take into account specific characteristic of the average returns on ordinary stocks and their patterns, simply describing them as anomalies. Many authors identified those

phenomena: De Bondt and Thaler (1985) state that average returns tend to be reverse on the long-term; Banz (1981) and Basu (1983) find that they are related to aspects such as firm's size, price earnings, book-to-market ratio, cash flow-price ratio, etc. Black and Scholes (1974) and Litzenberger and Ramaswamy (1982) focus on dividend yields effect on stock returns and find a non-linear positive relationship between the two variables.

The three-factor model explains the anomalies of returns, which tend to disappear by introducing those characteristics as size and book-to-market ratio capture the alterations that is not taken into account by systematic risk, β (Fama and French, 1992). Almost ten years later, Subrahmanyam (2010) argues that more than 50 variables may be used to predict stock returns.

Brennan (1970) derives a model considering a differential taxation of dividends extending the single period originally assumed. Black (1972) bases its research on the unlimited borrowing and lending at risk-free rate: he proposes a model which assumes unrestricted short-selling on risky assets, instead of risk-free assets. The result is that investors' decision making will be focused on the mean-variance efficient frontier rather than in the straight line, representing the risk-free borrowing and lending, tangent to the efficient frontier.

Jensen, Black and Scholes (1972) test the efficiency of CAPM by analysing the stock prices at NYSE during the period 1926-1966 through the original assumptions and by applying a two-factors model (where the return is also explained by a factor that is independent on the market; therefore, β is zero): the research results show that there is a significant difference between the slope predicted by the model and their findings; the CAPM tends to underestimate the expected returns in portfolios characterized by low β, and overestimate the ones with higher β.

The weak empirical support for the CAPM derives from the unrealistic assumptions on which the model is built and from the methodologies applied to validate the model (Roll, 1977; Roll and Ross, 1994; Levy, 1997). Furthermore, Roll (1977) argues that the failure of the CAPM tests is due to the utilisation of proxies, instead of the real market portfolio, as it is extremely difficult to find a market proxy close enough to the minimum variance frontier.

Most of the studies conducted over the years, since the CAPM has been developed, are focused on creating an alternative model to the original one, by introducing other factors that may explain the required return on asset; however, there is little evidence of attempts to validate it as an efficient a suitable model.

Williams (1977) introduces other variables that may affect the expected returns, such as subjective probabilities, individual wealth and risk aversion; the CAPM is validated under the assumption that the investors, accumulating information, make investment-decisions that converge to their beliefs and, thus, to the market portfolio. Admati (1985) and Levy, Levy and Benita (2006) empirically test the validity of CAPM under the heterogeneous assumption that investors may hold only a small amount of assets in their portfolios or investing in other categories of security, such as funds or other alternative investment instead of common stocks, having, therefore, a unique risk combination; the results show that on these circumstances, the model holds.

Merton (1973) develops an Intertemporal Capital Asset Price (ICAPM), also known as dynamic CAPM, assuming that investors are not only interested in maximising their wealth, but also focused on the opportunities to consume or to reinvest their wealth and how their wealth is changing by the time, considering variables such as labour income, prices of goods, the portfolio opportunities, the expectations, etc. Under these assumptions investors care about shocks to investment opportunities hedging their exposures through financial assets (Shih et al., 2014).

Lee (1976) improves the CAPM by introducing the assumption that all the investors have the same investment horizon, demonstrating how the model is explained by a nonlinear relationship.

Other studies (Lee, 1977; Schweser, 1978) focus on the skewness effect of the Capital Asset Price Model on expected returns; Harvey and Siddique (2000) argue that expected returns should have premium embedded in them for bearing risk, if they are characterised by systematic skewness: considering a conditional skewness the model holds, even with size and book-to-market elements.

Pastor and Stambaugh (2003) introduce a liquidity model analysing 10 portfolios

grouped for beta values, from 1966 to 1999 at NYSE, finding that market liquidity is an important factor in determining the price of assets: expected stock returns are correlated to market liquidity, in fact, the portfolios with high-liquidity betas are more profitable than the other built on low-liquidity betas as they tend to receive a compensation when the market is characterised by illiquidity. Furthermore, reproducing the three-factors CAPM by Fama and French (2004) they found that the model holds.

Despite the large number of models derived from the CAPM in order to improve it by relaxing some of the assumptions made during the 1960s, it is still, in its original form, one of the most popular instruments in Modern Finance.

The next section analyses the empirical evidences, across the world, resulting by testing the CAPM.

### 1.3 Empirical Evidences of the CAPM Efficiency

This study is concerned with the efficiency of the model. What is evident in the literature is that very little attention has been paid to this issue. In fact, most of the empirical evidences are oriented in expanding the original model, without considering its efficiency in its original form. What is certain is that the theoretical assumptions refer to an idealist world, but little studies have been focus on the relationship between the return and the systematic risk beta.

Yoshino and Santos (2009) examine the stock market in Brazil from 1998 to 2006 through 24 stocks, dividing the analysis in two periods in order to estimate the results in the first phase and to forecast them in the second round examination. The main conclusion of their study is that "*the Brazilian CAPM is dead*", recalling the expression used by Fama (1996) to indicate the inefficiency of the model and its difficulty in being tested. The reasons of the failure in an emerging market like Brazil find their roots in the existence of other explanatory variables: the market premium, a non-linear CAPM (the square of the market premium), the firm size, etc.; when added these variables, applying a Fully Modified OLS (FMOLS), the CAPM is efficient.

Bornholt (2013) tests the CAPM by analysing the three "inefficiencies" in the U.S.

market through 48 industries, from 1963 to 2009, finding and confirming that:

1. β anomaly, derived from the fact that portfolios composed by low beta stocks have higher average returns than the one predicted by the model, whereas portfolios characterized by high beta stocks show a lower average return, tends to reduce after 1993;
2. The book-to-market equity anomaly, or value anomaly, which observes that firms with high book-to-market equity ratio have higher average return than those which have a lower ratio, can be ignored if it is estimated the industry cost of equity;
3. The momentum anomaly, where the stocks with high average returns in one period (last 6 or 12 months) show higher average returns in the next period (Jegadeesh and Titman, 2001), continues through all the period examined.

The CAPM fails its application to industries, as it is more appropriate for stocks, however, with reference to anomalies "*If they are not permanent, then the CAPM may eventually be resurrected*" (Bornholt, 2013, p. 7).

In an efficient market, the stock prices reflect all the information available and, because market is considered rational, future prices cannot be predicted as they are characterised by the random walk theory (Malkiel, 1973; Fama, 1965). The Efficient Market Hypothesis (EMH) defined by its weak, semi-strong and strong form, does not explain how the capital market allocates resources efficiently; the CAPM extends this concept by arguing that the information is processed by rational individuals and that it reflects stock prices: in fact, investors, tend to require higher returns for higher risk taken (Dempsey, 2013).

However, in a real world where markets are not perfect and investors behave irrationally, overreacting to unexpected news and determining loser portfolios to outperform the winner ones, (De Bondt and Thaler, 1985), stock prices seem be characterised by predictability (Fama and French, 1986): the past can be a helpful predictor of the future.

Fama and French (1986) observe that the return of stocks listed on the NYSE from 1926 to 1985 tend to be characterised by mean-reversion. From 18 up to 5-year period examined the returns mean revert and then decrease. Poterba and Summers (1988) find that in U.S., and other 17 countries, although the randomness of prices

cannot be statistically rejected, there is a positive autocorrelation in returns over short-term, whereas it is negative over the long-period.
Basu (1977, p.681), analysing the relationship between equity performance and P/E ratios over 14 years (1957-1971), concludes that stock prices are inconsistent with the EMH theory, due to frictionless; furthermore, "[...] *low P/E portfolios did earn superior returns on a risk-adjusted basis, the proposition of the price-ratio hypothesis on the relationship between investment performance of equity securities and their P/E ratios seem to be valid*".

The failure of CAPM has been empirically demonstrated confirming the non-linear relationship between the systematic risk, β, and the expected return. However, some studies affirm the validity of the model and its importance in modern finance, still recognised after more than 50 years.
Clare, Priestley and Thomas (1998) use one-step estimator, despite the two-steps developed by Black et al. (1972), Fama and MacBeth (1973) and applied by Fama and French (1996; 2004), to analyse the UK stock market from 1980 to 1993. The result of the study shown a stable, positive and linear relationship between beta and the expected return on assets, whereas factors like book-to-market equity, leverage or EPS give a low contribution in explaining them.

Lee, Cheng and Chong (2016) examine the context of the emerging markets, by analysing the Kuala Lumpur Stock Exchange (KLSE) and its 60 stocks from 2010 to 2014, using weekly data: the CAPM seems to be a good indicator of the stock prices. The method applied is the two-phases regression (OLS and cross-sectional regression), followed by Basu and Chawla (2010); beta results positively related to the expected return and it is confirmed a linear relationship: "In summary, investors could use CAPM to estimate the behaviour and the systematic risk of the stocks in Malaysia before investing in stock market. This could be a way to minimize their downside risk as they understand the stock trend of the company and hence invest rationally" (Lee, Cheng ad Chong, 2016).

Hasan et al. (2011) study the relationship risk-return at Dhaka Stock Exchange

(DSE) from 2005 to 2009, a period of time including the financial crisis in 2008-2009, finding that CAPM is able to predict asset price efficiently; whereas Ali and Ali (2009), following the methodology developed by Fama and MacBeth (1973), analysing the DSE from 1998 to 2008, find an extremely weak support of the CAPM suggesting to consider other factors in order to explain the expected returns. Dayaratne (2010) compares the U.S. and Sri Lankan markets, using the Fama and French (1996) three factors model, demonstrating that whereas for the U.S. market the CAPM is validated, for the Sri Lankan market it results inefficient. Bouchaddekh, Bouri and Kefi (2014) test the standard CAPM at Tunisian Stock Market (period 2011-2013) finding a statically significant validity in predicting asset prices, however, the empirical evidences suggested the presence of anomalies: introducing the friction factors to the standard model, such as transaction costs, information costs and illiquidity, it seems efficient in explaining the stock prices; furthermore, the added factors are positively related to expected returns.

Obrimah, Alabi and Ugo-Harry (2015) argue that CAPM is an appropriate model to define the relationship between the systematic risk and the expected returns and it is significant in explaining the semi-strong form of the Efficient Market Hypothesis at Nigerian Stock Exchange (NSE). The authors examine, over a period of 10 years, 26 random stocks, applying the methodology of Kraus and Litzenberger (1976), the two-moment CAPM, by adding to the classic version of the model the investors' reaction to positive skewness in returns, and the methodology of Arditti (1967), by adding the element of idiosyncratic risk.

In general, whilst in developed countries the model seems not supported, or scarcely supported, by empirical evidence, in emerging countries, where the legal development is slower and, therefore, the financial development is slower as well, CAPM seems more accepted by evidences: the reason of this is due to the fact that in developed countries, with legal advanced systems, institutions may lead investors to be more willing of market inefficiencies (La Porta et al., 2006; Johnson et al., 2002). However, the empirical evidence in India shows the CAPM failure even in some emerging countries: Basu and Chawla (2010), follow the method applied by

Fama and Macbeth (1973) in analysing 50 stocks at Indian Stock Exchange. After building 10 portfolios of 5 stocks per each they test the model through two phases (OLS and cross-sectional), the study highlights that CAPM is not appropriate for the Indian Stock Market due to the fact that it does not take into account other variables (imperfect market proxy, inflation, tax effects, etc.) that may affect the determination of the asset prices; Basu and Chawla (2010) associate the failure of the model to its assumption and to the restricted sample size adopted. Bilgin and Basti (2014) analyse the Istanbul Stock Exchange (ISE) from 2003 to 2011, dividing the samples in four sub-periods: they test the standard CAPM and the version derived by Pettengill et al. (1995), which consider a conditional model that takes into account the up and down of the market (when it is bearish the trade-off between risk and return is negative, when it is bullish it is positive). The results derived from the study confirm the inappropriateness of the CAPM, in both version, in the prediction of the asset prices at Istanbul Stock Exchange.

Ferreira and Monte (2015), analyse the context of Eurozone, in particular Portugal, finding that the traditional CAPM cannot be rejected for the Lisbon Stock Exchange and that the systematic risk is an important factor in explaining the expected return of assets. However, the research may be affected by the size of the Stock Exchange (18 stocks for a period of 14 years).
Sauer and Murphy (1992) examine the total returns of 140 stocks (109 of 249 have been excluded because not continuously traded) at Frankfurt Stock Exchange, for the period of time 1968-1988, finding a positive trade-off between risk and return; furthermore, the comparison between the traditional model with the CCAPM (Consumption CAPM, which considers a multi-period) results in an outperformance of CAPM.

Hwang, Gao and Owen (2012, p. 101) study the validity of CAPM in UK, extrapolating a sample of 70 stocks from FTSE 100, from 1996 to 2007, finding that the model is rejected due to the presence of idiosyncratic risk, concluding: "*The traditional CAPM can be used in practice if idiosyncratic risk and the nonlinear relationship between beta and return are considered*".

This study's purpose is to validate the CAPM and to understand its efficiency pre, during and post the financial crisis in order to establish a trend and examine the relationship between beta and return in different period of time with different market behaviour; Bilić, Dimitrić and Škalamera-Aliović (2016) affirm that the influence of the crisis should validate the CAPM when there is a higher difference, in terms of time, from the crisis. Pettengill et al. (1995) examine the model in bearish and bullish market, finding that in bearish market the risk-return relationship tends to be negative (and positive in bullish market). As there is an evidence of the impact of shocks in the market on the CAPM, the aim of the analysis is to investigate this effect at Irish Stock Exchange, where the crisis, which occurred in 2007-2008 had a big impact, financially, economically and fiscally, in Ireland.

The Capital Asset Pricing Model, despite the criticism and the lack of consensus about its validity, represents the most common methodology in corporate finance for the determination of the cost of equity capital: in a survey conducted by Graham and Harvey (2001) of 392 CFOs, of Fortune 500 corporations, about 73.5% of them apply the CAPM, followed by the methodology of the average stock returns and the multi-beta CAPM by adding extra risk factors, such as: business cycle risk, interest rate risk, exchange rate risk, inflation risk and other macroeconomic factors (Chen, Roll and Ross, 1986); fundamentals (Fama and French, 1992); momentum (Jegadeesh and Titman, 1993). Furthermore, large size firms with low leverage, high foreign sales and publicly traded, are more inclined to use the CAPM rather than private and small size firms. Bruner et al. (1998) demonstrate that 85% of companies surveyed use the CAPM or an extension of the model.

The following study, is focused on testing the validity of the Capital Asset Pricing Model at Irish Stock Exchange (ISE) in order to establish if the relationship between return and systematic risk is linear and positive as predicted by the model. Moreover, the analysis is conducted over three sub-periods which comprehend pre, during and post-crisis in order to understand the crisis effect on the model.
With reference to the Irish market, it seems there is little empirical evidence related to testing the validity of Capital Asset Pricing Model.

The motivation behind the following research is given by the little empirical evidence which characterises the Irish context, Lorenz and Trück (2008) study the risk-return relationship, through the CAPM, of several assets, focusing on the property market in the Eurozone; with reference to Ireland the explanatory power of the systemic risk is very low and the relationship is negative, thus the CAPM, for property market, is not validated. However, the focus of this study is on the stock market, which presents different characteristic as it is more liquid than the property market. Therefore, due to the large application of the model in finance and the little evidence of its validity during the crisis, the study aims to investigate the efficiency of the CAPM at Irish Stock Exchange, answering the research question formulated in the next section and following a statistical approach, that will be discussed in the next chapter.

### 1.4 The Research Question

The Capital Asset Pricing Model, after more than five decades is still applied in modern finance, despite the criticism about its theoretical limits.

The model states that the required return on assets and the systematic risk, beta, are related by a positive and linear relationship, thus, the returns are only explained by one factor: the risk.

The study will explore the validity of the model in its original form, as developed by Sharpe (1964), Lintner (1965) and Mossin (1966), analysing the relationship risk-returns through a system of linear regressions and t-tests over the period of time 2001-2011, divided in tree sub-period (2001-2006, pre-crisis; 2007-2008, during the crisis; 2009-2011, post-crisis).

Due to little empirical evidence within the Irish market and the impact of the global financial crisis on the Capital Asset Pricing Model, the research question that the study is attempting to answer is the following:

**“Is the Capital Asset Pricing Model valid at Irish Stock Exchange over the period 2001-2011? Is the relationship risk-return positive and linear?”.** Furthermore, the study will analyse the pre, during and post-crisis occurred in 2007-2008, finding out the influence of the global financial collapse on the CAPM.

While analysing the risk-return relationship, the thesis could support further research in order to develop a more sophisticated model that best "suits" the Irish context and to focus on the influences of the global financial crisis as a momentum for changes in market behaviour.

## Chapter 2. Methodology

The following chapter introduces the methodology adopted to answer the purpose of the study, which involves in verifying the validity of the Capital Asset Pricing Model at Irish Stock Exchange (ISE), observing the relationship between the asset returns and the systematic risk, identified by β.

According to Sharpe (1964), Lintner (1965) and Mossin (1966), the relationship between the two variables should be linear and positive, as the returns on the assets should be only explained by the factor β.

The method pursued to validating the CAPM consists in a quantitative analysis technique which allows to establish the statistical relationship between the variables above-mentioned and follows the Fama and Macbeth (1973) methodology, replicated by several authors: Hwang, Gao and Owen (2012), who examine the UK market; Basu and Chawla (2010), in the Indian Stock Exchange and Lee, Cheng and Chong (2016), who's the empirical study is based on the Malaysian Stock Market.

The research philosophy is to investigate the efficiency of the CAPM, by observing the relationship between risk and return, which should be positive and linear, according to its theory. The study follows the framework of positivism, which is defined as the measurement, observation and data collection through an objective and quantitative approach which involves in a statistical analysis. According to Crowther and Lancaster (2008), positivism leads to a deductive approach, rather than an inductive approach, as the research is stemmed from a specific theory (in this case CAPM and its theoretical assumptions). The deductive approach follows the nature of an experiment, as the data are collected, elaborated and the resulting outcomes are, then, observed through a mono-method, which consists in a linear regression and its statistical t-test. The time horizon is cross-sectional, as it is

defined a priori: the data collection is within a period of time which goes from January 2001 to December 2011.

The chapter is organised in four paragraphs: section 2.1 will consider the data sample collection; section 2.2 will describe the methodology applied for the construction of portfolios; section 2.3 will introduce the linear regression and the hypothesis test which will permit to conclude the analysis on the Capital Asset Pricing Model; section 2.4 will focus on the limitation of the methodology adopted.

### *2.1 Data Collection*

The data collection consists of historical closing prices of 25 companies from different sectors of the Irish economy, extrapolated through the database of the Irish Stock Exchange and elaborated through the instrument Microsoft Excel.

The ISEQ is in existence since 1793, and counts 55 companies trading more than 35.000 securities in 85 countries. In 2014 it changed its corporate structure in a public limited company (Plc); the companies can be listed in three markets: the ESM (Enterprise Securities Market), for high-growth companies at the earlier stages; the MSM (Main Security Market), for companies with necessity of funds; and, eventually, the ASM (Atlantic Security Market) for multinational companies.

According to Black, Jensen and Scholes (1972), the stockholder invests in equal measure to all the stocks traded at the index for the period considered, however the final list of the primary data selected comprises 25 companies (instead of 55), due to the unavailability of the 30 companies left over the period of time examined: from January 2001 to December 2011. Furthermore, the companies belong to different industries and are mostly traded at the Enterprise Security Market (ESM).

The period of time examined is subdivided in three period of time: from 2001 to 2006, in order to observe the validity of the CAPM before the global financial crisis, avoiding destabilising effects; from 2007 to 2008, the period on which the crisis spread; and, eventually, 2009-2011, the interval of time after the crisis. The results will be, then, compared and contrasted.

The primary data, constituted by 569 observations, collected from the ISE database

(www.ise.ie), are the weekly closing prices of every company for the period of time considered; the day of the week selected is Wednesday, in order to avoid the day of the week and the weekend effects (Barone, 1990).

The reason of the weekly observations is owed to the fact that daily data are characterised by noise and volatility, whereas monthly data can alter the risk-return relationship, due to the longer period of time (Basu and Chawla, 2010), and, furthermore, the sample would have been too small for the purpose of the study.

Consequently, the primary data present the following characteristics: they are numerical data, ratio data (as it is possible to calculate the relative differences between two data values) and continuous data, as they can take any value (within a range).

Once collected the primary data, the asset returns are calculated through the relative change of closing prices:

$$(p_1 - p_0 / p_0)$$

Where $p_1$ represents the closing price at time 1 and $p_0$ represents the closing price at time 0.

The secondary data, composed by 568 observations, and so calculated, are analysed through the descriptive statistics, in order to describe and compare the variables numerically; they represent the base for the construction of the portfolios, which will be described in the next section.

## 2.2 The Construction of Portfolios

In order to build the portfolios, the first step is to estimate beta, β, for any of the 25 companies selected from the Irish Stock Exchange.

As defined in the previous sections, the systematic risk beta represents the slope of the relation between the return on the assets and the return on the market. Therefore, its estimation can be made by dividing the covariance of the asset returns and the return on the market per the variance of the return on the market, through the following formula:

$$\beta_i = Cov (R_i, R_m) / Var (R_m)$$

Where:

- **$\beta_i$** is the systematic risk of the stock considered;
- **Cov ($R_i$, $R_m$)** is the covariance of asset returns and return on the market;
- **Var ($R_m$)** is the variance of the return on the market.

The proxy for the real market portfolio, that gives the return on the market, is the ISE index, calculated as the relative changes of the weekly closing prices from January 2001 to December 2011 and extrapolated from the ISE database; this should avoid the proxy problems argued by Roll (1977): the author states that one of the fallacies of the CAPM depends on the proxy choices, as it is difficult, in the real world, to find a market proxy close enough to the real market; however the representative of the Irish market is effectively its index, for this reason it is denoted the real market portfolio for Ireland.

This approach is in line with Fama and MacBeth (1973); Hwang, Gao and Owen (2012); Basu and Chawla (2010); Lee, Cheng and Chong (2016), who built portfolios using beta and assuming equal weights in each stock.

The estimation of beta is done with a semi-annual periodicity in order to increase the number of observations: for the 25 companies selected, the number of betas' observations is 550.

Once estimated β it is built the portfolios by descending order of the systematic risk: 110 portfolios of 5 stocks each are built semi-annually; portfolio 1 is the highest beta, whereas the portfolio 110 the lowest one. The choice of building the portfolios with 5 stocks is for the purpose of diversification, in order to eliminate the idiosyncratic risk, specific for each stock (Markowitz, 1953; Sharpe, 1964; Lintner, 1965). However, the choice of the number of stocks in a portfolio is arguable: empirical evidences from studies conducted by Statman (1987), who supports the theory that a portfolio can be defined as diversified if it contains at least 30 stocks; conversely Domien et al. (2007) argues that 100 stocks are not enough for diversification purposes. Anghel (2013) affirms that 7 stocks may be sufficient for efficient portfolios and Amanulla et al. (1998) support the evidence of a minimum of 5 stocks per portfolio.

Due to the companies available for the period of time selected, the portfolios are composed by the minimum amount of stocks: 5 per portfolio, furthermore, the creation of the sets of stocks by descending order of β allows to achieve a certain

diversification, as the portfolios are composed by stocks which belong to different industries.

For any of the 110 portfolios it has been calculated the beta of the entire portfolio, through the sum of the betas of each stock in the portfolio equally weighted (20%), the return and the risk (represented by the standard deviation), by using a system of matrices, considering as input the excess returns (the asset returns are subtracted from the average return of the asset):

1. Expected Return in the Portfolio

$$\mathbb{E}[r_p] = \mathbf{w}^T \mu = \begin{pmatrix} w_1 & w_2 \end{pmatrix} \begin{pmatrix} \mathbb{E}[r_1] \\ \mathbb{E}[r_2] \end{pmatrix} = w_1 \mathbb{E}[r_1] + w_2 \mathbb{E}[r_2]$$

Where: $\mathbf{Er_p}$ represents the expected return in the portfolio, $\mathbf{w^T}$ is the transpose weight of each stock and $\boldsymbol{\mu}$ is the average of returns.

2. Risk

$$\begin{aligned} \sigma_p^2 = \mathbf{w^T \Omega w} &= \begin{pmatrix} w_1 & w_2 \end{pmatrix} \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{pmatrix} \begin{pmatrix} w_1 \\ w_2 \end{pmatrix} \\ &= \begin{pmatrix} w_1\sigma_1^2 + w_2\sigma_{21} & w_1\sigma_{12} + w_2\sigma_2^2 \end{pmatrix} \begin{pmatrix} w_1 \\ w_2 \end{pmatrix} \\ &= w_1^2\,\sigma_1^2 + w_2 w_1\,\sigma_{21} + w_1 w_2\,\sigma_{12} + w_2^2\,\sigma_2^2 \\ &= w_1^2\,\sigma_1^2 + w_2^2\,\sigma_2^2 + 2\,w_1 w_2\,\sigma_{12} \\ &= w_1^2\,\sigma_1^2 + w_2^2\,\sigma_2^2 + 2\,w_1 w_2 \sigma_1 \sigma_2\,\rho_{12} \end{aligned}$$

Where: $\boldsymbol{\sigma^2_p}$ is the variance of the portfolio, $\mathbf{w^T}$ is transpose weight of each stock, $\boldsymbol{\Omega}$ is the variance-covariance matrix, $\mathbf{w}$ is the weight of each stock and $\boldsymbol{\rho}$ is the correlation (built through matrix by dividing the variance-covariance matrix per the standard deviation matrix).

The semi-annual portfolios are then grouped in the three period blocks: pre-crisis, 2001-2006, crisis, 2007-2008, and post crisis, 2009-2011, following the study conducted by Bilgin and Basti (2014) who analyse the Istanbul market in 4 periods of time (2003-2011), based on the beliefs that there is a positive or negative

relationship between risks and returns during bullish or bearish market periods. The three stages analysis will give an understanding of the influence of the market on the Capital Asset Pricing Model which will be validated through a linear regression per stage the statistical t-test, as described in the next section.

### 2.3 The Linear Regression and the Hypothesis Test

The Capital Asset Pricing Model in its original version, as developed by Sharpe (1964), Lintner (1965) and Mossin (1966), states that the required rate of return depends on the systematic risk beta:

$$(R_i - R_f) = \beta\ (R_m - R_f)$$

Where:

- $(R_i - R_f)$ is the required rate of return, in particular, the return of the asset reduced by the risk-free rate ($R_f$ is extrapolated from the ISE database and it is the 10 years' government bond, the Irish Treasury Bill, as it is considered a risk-free investment);
- $\beta$ represents the systematic risk;
- $(R_m - R_f)$ is the market risk premium and Rm represents the expected return on the market.

To address the research question at the centre of this study, the validation of the Capital Asset Pricing Model is tested through a linear regression: the aim is to observe if the systematic risk beta can explain positively the asset return and their relationship is linear.

The linear regression is defined as following (Fama and Macbeth, 1973):

$$(R_i - R_f) = \alpha_i + \beta_i\ (R_m - R_f) + \varepsilon_i$$

Where:

- $(R_i - R_f)$ is the required rate of return, in particular, the return of the asset minus the risk-free rate;
- $\beta_i$ represents the systematic risk of the portfolio;
- $\alpha_i$ is the intercept of the portfolio
- $(R_m - R_f)$ is the market risk premium and Rm represents the expected return on the market.
- $\varepsilon_i$ is a random error term, identified as idiosyncratic or unsystematic risk and it is

related to specific and unique characteristics of the assets in a portfolio: it can be mitigated through diversification, unlike the systematic risk which is undiversifiable as it impacts all the portfolio and depends on fluctuation in the market, in interest rates, etc.

The analysis on the CAPM is extended over 11 years' time, from January 2001 to December 2011, and the observation is made grouping the periods in three stages: pre-crisis (2001-2006), crisis (2007-2008) and post-crisis (2009-2011).

The linear regression is defined for all the three stages and, through a comparison of the results, it is possible to have a better understanding of the model before, during and after the crisis, as the systematic risk can result affected by the different events occurred in that period of time.

Recalling the purpose of the study, the CAPM is validated only if the relationship between risk and return is positive and linear; therefore, the following step is to test, through a t-test (Basu and Chawla, 2010; Hwang, Gao and Owen, 2012; Lee, Cheng and Chong, 2016), at 95% level of confidence, the intercept of the linear regression by defining the following hypothesis:

$$\text{Null Hypothesis} \rightarrow \mathbf{H_0: \alpha_i = 0}$$

$$\text{Alternative Hypothesis} \rightarrow \mathbf{H_1: \alpha_i \neq 0}$$

The Capital Asset Pricing Model is satisfied in its assumptions if the intercept is equal to zero: in this case the null hypothesis $\mathbf{H_0}$ is accepted and the relationship is linear and positive; in fact, according to the CAPM's theory, the return is a linear function of the risk-free rate and the market risk premium related to the systematic risk born. However, if it is rejected the CAPM is not validated. It could mean that the portfolio returns are depending not only by beta, the systematic risk, but on other factors, non-contemplated in the model and it can result in a stimulus for further researches in the future. Furthermore, it is necessary to consider the limitation of this study, which are to be discussed in the next section.

### 2.4 Limitations

Empirical evidences (Roll, 1977; Banz, 1981; Fama and French, 1992) argue the failure of the Capital Asset Pricing Model because of its assumptions, which are

unrealistic and tend to make difficult to test its validity.

The following study, aware of its limitation in the CAPM theory itself, has the purpose to investigate the positive and linear relationship, predicted by the model, between risk and return at Irish Stock Exchange during three sub-periods: 2001-2006, pre-financial crisis; 2007-2008, during the financial crisis; 2009-2011, after the financial crisis.

To address the analysis, it is applied a linear regression and a t-test of the intercept, to assess whether only one factor in influencing the required return on assets or there are other dependencies.

The model so defined brings some limitations, which may lead to distortions in the outcome:

- The assumptions in the model are per se a limitation as they idealise a world under perfect conditions (Fama and French, 2004);
- The period of time analysed (2001-2011), 11 years, may be restricting; the data collection for this period is limited at 25 companies' stock returns rather than the whole list of firms listed at ISE (55), thus the sampling may be too small, indicating that the period of time may be enlarged to include more data;
- The estimation of beta, due to unavailability of real data, which highlights anomalies due to events occurred over the years;
- Empirical evidences highlight that there is more than one factor that influence the stock returns (Jensen, Black and Scholes, 1976; Fama and French, 1992), however it is arguable that, in general, there is no consensus about the validity.

Aware of the limitations the methodology applied to investigate the validity and efficiency of the Capital Asset Pricing Model is then analysed in the next paragraph, by observing the outcomes of the quantitative approach described.

## Chapter 3. Analysis/Findings

In this chapter the findings from analysis of the Capital Asset Pricing Model in the

Irish context in order to observe the practicability of the model and to answer the purpose of the study.
It is divided in three sections: section 3.1 will discuss about the descriptive statistics on the stock returns of the 25 companies traded at Irish Stock Exchange; section 3.2 will analyse the portfolios and their characteristics; section 3.3 will argue the results obtained from the linear regression and the statistical t-test, drawing the conclusion of the whole analysis.

### 3.1 The Descriptive Statistics of the Stock Returns

The analysis of the study conducted in order to validate the Capital Asset Pricing Model, and to understand its efficiency at Irish Stock Exchange, starts with the descriptive statistics of the 25 companies selected from the ISE database for the period January 2001 – December 2011.
The trend of the closing prices shows a significant downfall over the period of the global financial crisis, by more than 50% the value during 2001 for most of the companies examined; an interesting observation is that the price is not recovered after the crisis, but increases slowly till 2011.
The primary data collected are then utilized for calculating the stock returns, which are the secondary data and which are the object of the descriptive statistics. As a consequence of the financial collapse in 2008, the returns are characterized by negative or small values, with a high level of risk associated.

The descriptive statistics allows to observe and describe the data focussing on two aspects: the central tendency and the dispersion. The central tendency is useful for understanding values which are common, average or middling; whereas the dispersion indicates how the variables are dispersed around the central tendency.
The stock returns for the 25 companies, as given in Table 1, summarily, differ each other, as they belong to different industries and, thus, they present diverse characteristics. The sectors which the companies belong are:

- Banking (Allied Irish Banks Plc, Bank of Ireland Group Plc, Permanent TSB Group Holdings);

- Building Materials and Construction (Abbey Plc, CRH Plc, Kinspan Group Plc);
- Recruitment (CPL Resources Plc);
- Betting (Paddy Power Betfair Plc);
- Airline (Ryanair);
- Retail and Food and Beverage (Diageo Plc, Glanbia Plc, Kerry Group Plc, Tesco Plc)
- News and media (Independent News & Media Plc)
- Oil and gas (Aminex Plc, Tullow Oil Plc, Providence Resources Plc)
- Mineral resources (Ovoca Gold Plc, Ormonde Mining Plc, Kenmare Resources Plc);
- Shipping and Transport (Irish Continental Group Plc)
- Financial Services and Insurance (IFG Group Plc, FBD Holdings Plc, Donegal Investment Group Plc)
- IT Services (Datalex Plc).

The central tendency, of the 568 observations, represented by the mean, mode and median, results extremely various: the mean goes from a range of -0.009 to a maximum of 0.1644; the mode, that is the value which occurs more frequently, is interestingly zero for all the 25 companies, it means that the volatility of closing prices is mitigated through a weekly periodicity, rather than a monthly or daily observations (Basu and Chawla, 2010); the median is comprised within a range from -0.002 to 0.0049 and, unlike the mean, it is not affected by skewed values, as they are ranked in ascending order and it is found the mid-point in the distribution ($50^{th}$ percentile).

The dispersion, represented by the standard deviation, shows higher values for companies which belong to different industries, rather than the ones which are in the banking sector; this aspect gives information about the riskiness of the assets.

Kurtosis and Skewness are important measures for describing the distribution of the variables: kurtosis indicates the shape of the distribution and its peak, which designates normality if its value is 3; skewness is related to the symmetry, which for a normal distribution should be 0. The variables seem to be characterized by a more peaked shape than the Gaussian distribution as the value are much greater

than 3; only 4 companies out of 25 are negatively skewed and the distribution is asymmetric.

**Table 1: Descriptive Statistics of stock returns of the 25 companies traded at Irish Stock Exchange.**

*Descriptive Statistics*

| Company Codes | DOY | AIB1 | DOP | BIRG | DQ5 | CRG | DLE | GUI | DQ7 | EG7 | GL9 | IJG | IPDC | IR5B | JEVA | KRZ | KRX | ORQ | OVXA | PPB | IL0A | PZQA | RY4C | TCO | TQW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | 0.0173 | -0.0015 | 0.0014 | -0.0020 | 0.0053 | 0.0007 | -0.0009 | 0.0004 | 0.0020 | 0.0017 | 0.0048 | 0.0014 | -0.0838 | 0.0024 | 0.1644 | 0.0017 | 0.0031 | 0.0063 | 0.0148 | 0.0058 | -0.0042 | 0.1466 | 0.0006 | 0.0003 | 0.0065 |
| Standard Error | 0.0174 | 0.0057 | 0.0045 | 0.0050 | 0.0035 | 0.0020 | 0.0038 | 0.0004 | 0.0020 | 0.0020 | 0.0021 | 0.0029 | 0.0619 | 0.0017 | 0.0298 | 0.0014 | 0.0028 | 0.0048 | 0.0097 | 0.0019 | 0.0046 | 0.1403 | 0.0028 | 0.0003 | 0.0024 |
| Median | 0.0000 | -0.0022 | 0.0000 | -0.0027 | 0.0000 | 0.0009 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | -0.0034 | 0.0000 | 0.0000 | 0.0010 | 0.0043 | 0.0000 | 0.0000 | 0.0049 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0049 |
| Mode | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Standard Deviation | 0.4145 | 0.1366 | 0.1073 | 0.1193 | 0.0835 | 0.0486 | 0.0904 | 0.0099 | 0.0468 | 0.0466 | 0.0510 | 0.0701 | 1.4754 | 0.0401 | 0.7114 | 0.0322 | 0.0656 | 0.1135 | 0.2321 | 0.0454 | 0.1097 | 3.3442 | 0.0665 | 0.0077 | 0.0560 |
| Sample Variance | 0.1718 | 0.0187 | 0.0115 | 0.0142 | 0.0070 | 0.0024 | 0.0082 | 0.0001 | 0.0022 | 0.0022 | 0.0026 | 0.0049 | 2.1767 | 0.0016 | 0.5061 | 0.0010 | 0.0043 | 0.0129 | 0.0539 | 0.0021 | 0.0120 | 11.1840 | 0.0044 | 0.0001 | 0.0031 |
| Kurtosis | 548.1682 | 72.2927 | 10.1213 | 24.3254 | 11.7148 | 2.5445 | 3.5244 | 225.5938 | 5.4237 | 6.0039 | 3.2427 | 4.8957 | 266.3758 | 7.6434 | 5.5148 | 1.7546 | 4.1250 | 14.8507 | 216.7732 | 2.2953 | 10.6905 | 566.1719 | 14.6924 | 568.0000 | 4.8585 |
| Skewness | 23.1871 | 5.2426 | 1.5497 | 2.6326 | 1.2419 | 0.0115 | 0.4757 | 6.3030 | 0.3669 | 0.0084 | 0.4557 | 0.3944 | -15.8665 | 0.0996 | 2.0781 | 0.0828 | 0.0346 | 0.6460 | 11.8151 | -0.0779 | -0.1641 | 23.7754 | -1.6978 | 23.8328 | 0.7131 |
| Range | 10.7036 | 2.6301 | 1.1685 | 1.7029 | 1.0000 | 0.4347 | 0.7782 | 0.3035 | 0.5247 | 0.5263 | 0.4474 | 0.7126 | 32.1770 | 0.4901 | 4.6000 | 0.2558 | 0.6379 | 1.6800 | 5.1071 | 0.3788 | 1.3339 | 80.5375 | 0.8031 | 0.1829 | 0.5734 |
| Minimum | -0.9111 | -0.7178 | -0.3485 | -0.5678 | -0.4000 | -0.2033 | -0.3448 | -0.1292 | -0.2593 | -0.2654 | -0.2167 | -0.3333 | -26.0000 | -0.2786 | -0.8000 | -0.1253 | -0.2986 | -0.9022 | -0.7500 | -0.1788 | -0.7037 | -0.8923 | -0.5336 | 0.0000 | -0.2450 |
| Maximum | 9.7925 | 1.9123 | 0.8200 | 1.1351 | 0.6000 | 0.2314 | 0.4333 | 0.1743 | 0.2654 | 0.2609 | 0.2308 | 0.3793 | 6.1770 | 0.2115 | 3.8000 | 0.1305 | 0.3393 | 0.7778 | 4.3571 | 0.2000 | 0.6302 | 79.6452 | 0.2695 | 0.1829 | 0.3285 |
| Sum | 9.8486 | -0.8630 | 0.8220 | -1.1279 | 3.0161 | 0.3945 | -0.5109 | 0.2171 | 1.1351 | 0.9455 | 2.7310 | 0.7757 | -47.6093 | 1.3721 | 93.3914 | 0.9891 | 1.7417 | 3.5891 | 8.4186 | 3.2924 | -2.3612 | 83.2740 | 0.3194 | 0.1829 | 3.6692 |
| Count | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 | 568 |
| Confidence Level(95.0%) | 0.0342 | 0.0113 | 0.0088 | 0.0098 | 0.0069 | 0.0040 | 0.0075 | 0.0008 | 0.0039 | 0.0038 | 0.0042 | 0.0058 | 0.1216 | 0.0033 | 0.0586 | 0.0027 | 0.0054 | 0.0094 | 0.0191 | 0.0037 | 0.0090 | 0.2756 | 0.0055 | 0.0006 | 0.0046 |

### 3.2 The Portfolios

The Capital Asset Pricing Model is utilized as a representative of the estimation of the asset returns and the diversification in portfolio construction, in order to mitigate the risk and to eliminate the idiosyncratic risk embedded in stocks.

The calculation for portfolio formation and beta estimation are equal-weighted (Black, Jensen and Scholes, 1972; Fama and MacBeth, 1973; Basu and Chawla, 2010; Hwang, Gao and Owen, 2012; Lee, Cheng and Chong, 2016): the output is characterised by 110 portfolios composed by 5 stocks each.

The estimation of the semi-annual beta, for any of the 25 companies selected, for the period of time January 2001 – December 2011, highlights anomalies in beta values as they are not comprised in the range [-1; +1], but exceed it in an evident manner (Appendix, Table 1). The company Independent News & Media Plc, an organisation specialised in the media sector, with a market capitalisation of €180.798m (www.bloomberg.com), shows an estimated beta value of -22.73 during the second semester of 2009 caused by a decrease in share prices due to reported losses, during the financial collapse, of €161.4m; in 2001 the share price was, on the average, €3.10, whereas in 2009 about €0.19 (The Guardian, 2009).

A similar case is represented by Providence Resources Plc, a company in the oil and gas sector with a market capitalisation of €107.579m (www.bloomberg.com): in 2010 the value of the estimated beta is enormous: 139.35. Observing the share price trend over the years it is evident a large increase from €0.03 to €2.5 in one week (from 25/05/2010 to 02/06/2010): the company operated a reverse stock split, in the measure of 6-1, grouping 6 shares in 1 (www.providenceresources.com).

Despite the above-mentioned anomalies, the estimation of beta, for the 25 companies traded at Irish Stock Exchange, ranges in a broadly manner, highlighting a variegated systematic risk due to the different businesses which the companies belong.

According to the CAPM theory (Treynor, 1962), the higher the beta, the higher the asset return, however some portfolios register a negative return (Appendix, Table 2 - 12): i.e. Portfolio 1 has a beta of 1.38 and a return of -0.2%, whereas Portfolio 92

has a beta of 1.02 and a return of 2%. The evidence of the beta estimations supports the study of Lee, Cheng and Chong (2016) about the Malaysian market and contradicts, in part, the CAPM theory, as the results are not homogeneous in terms of systematic risk-return relationship. It also supports the study of Hasan et al. (2011) who analyse the CAPM at Dhaka Stock Exchange (DSE), finding no significance of the model as indicator for Bangladesh, but linearity between risk and return; however, they find that for higher betas the assets returns are higher, but similarly to this study they tend to vary arbitrarily.

The 110 returns on the portfolios are then pooled together in three period's blocks: pre-crisis, 2001-2006; crisis, 2007-2008 and post-crisis 2009-2011. This subdivision of time will give a better understanding of the validity of the CAPM over time, and, in particular, if there it is affected by the global financial crisis in some way.

The next section will illustrate the findings of the analysis, consisting in a set of linear regression for the contemplated periods of time, followed by the hypothesis testing of the intercept, in order to examine the efficiency of the Capital Asset Pricing Model and to exclude the existence of other dependencies for the stock returns, except the systematic risk beta.

### 3.3 Validation of the CAPM

The validation of the Capital Asset Pricing Model requires the positive and relationship between the return on the stocks and the systematic risk, β; doing so, the model confirms that β is the only factor that influences excess portfolio returns (the returns reduced by the risk-free rate).

The test of the CAPM starts with gathering the returns on the 110 portfolios for the period of time 2001-2011 (semi-annually) in three period's time and calculating the excess returns, reducing them by the risk-free rate and building the linear regression model:

$$(R_i - R_f) = \alpha_i + \beta_i (R_m - R_f) + \varepsilon_i$$

Where: $(R_i - R_f)$ is the excess return of every portfolio and represents the dependent variable; $\alpha_i$ is the intercept that has to be tested and should be equal to zero, in order

to exclude other dependencies; $\beta_i$ **(**$R_m$ **–** $R_f$**)** is the independent variable represented by the systematic risk $\beta_i$ and the risk premium (the premium an investor is expected to receive for the burden of risk borne).

The linear regression indicates that the excess returns are function of systematic risk.

The period of time analysed has been divided in three blocks (Bilgin and Basti, 2014) and its descriptive statistics is given in Table 2, below:

- pre-global financial crisis (2001-2006): the observation collected for this period of time are 60, the central tendency shows a mean of -0.015, a mode of -0.002 and a median of -0.006; the dispersion (standard deviation) is 0.018; the kurtosis is -0.52 which gives information about the distribution and its peak, in this case has light tails and it does not follow normality, as its value is different from 3; the skewness, -1.07, indicates asymmetry as the normal distribution has skewness of zero, and the left-tail is longer than the right-tail.
- crisis (2007-2008): the observation collected are 30, the central tendency shows a mean of -0.017, a mode of -0.006 and a median of -0.018; the standard deviation is 0.008; the kurtosis is -0.89 which results in a light tail distribution; the skewness, 0.39, indicates a light right-tail asymmetry.
- post-global financial crisis (2009-2011): the observation collected are 20, with mean -0.005, a mode -0.002 and a median of -0.005; the standard deviation is 0.003; the kurtosis is -0.80 which results, like the other two periods of time, in a light tail distribution; the skewness, -0.31, indicates a light left-tail asymmetry.

**Table 2: Descriptive Statistics of Independent Variable Rm-Rf for the stages 2001-2006, 2007-2008, 2009-2011.**

| *Independent Variable (Rm - Rf)* | *2001-2006* | *2007-2008* | *2009-2011* |
|---|---|---|---|
| Mean | -0.014855598 | -0.017513 | -0.004928 |
| Standard Error | 0.002375725 | 0.0017419 | 0.0005546 |
| Median | -0.00568385 | -0.018436 | -0.005134 |
| Mode | -0.001986105 | -0.005932 | -0.00181 |
| Standard Deviation | 0.018402288 | 0.0077898 | 0.0030375 |
| Sample Variance | 0.000338644 | 6.068E-05 | 9.226E-06 |
| Kurtosis | -0.517967239 | -0.893743 | -0.804198 |
| Skewness | -1.070660796 | 0.3891644 | -0.314776 |
| Range | 0.054573771 | 0.0213156 | 0.0090174 |
| Minimum | -0.051990195 | -0.027247 | -0.010045 |
| Maximum | 0.002583576 | -0.005932 | -0.001028 |
| Sum | -0.891335882 | -0.350253 | -0.14783 |
| Count | 60 | 20 | 30 |
| Confidence Level(95.0%) | 0.004753815 | 0.0036458 | 0.0011342 |

The independent variables during the three stages examined shows a change in dispersion during the crisis and the post-crisis: in pre-crisis its value is approximately 1.8%, whereas in the period 2007-2008 it decreases to 0.8% and 0.3% in the post-crisis phase. This changes indicate that the market was characterized by more risk aversion than before, due to the collapse of the financial system, which impacted Ireland with severity; in fact, is it possible to notice a fall in stock prices and returns, which tend to be negative during and in the first couple of years after the crisis.

With regard to the distribution and its symmetry, kurtosis and skewness demonstrate, respectively, light-tails and high peaks and asymmetry in all the three stages, however the pre and post-crisis highlight left-tails asymmetry, whereas during the crisis the asymmetry tends to be on the right side of the distribution.

The relationship between the risk and returns of the stocks in the portfolios is examined via a linear regression for each of the three periods.

During the pre-crisis period, from 2001 to 2006, there is a weak positive correlation between the variables (Multiple R = 15%) and the independent variable accounts for $R^2$ = 2.26% of the variation in the dependent variable: the systematic risk, β,

does not have a strong explanatory power for the excess returns; it means that the remaining 97.74% is accounted for missing variables.

Fama and French's (1992, 1996) three-factors model, for example, can be an approach to identify the missing variables, taking into account the stock market returns, the book-to-market value and the size, identified with the market capitalization. Furthermore, there is in literature a broad attempt to develop multi-factor models, as the evidences suggest that there is more than one factor that could explain the excess returns on a stock (Sharpe, 1998; Banz, 1981; Basu, 1983; Litzenberger and Ramaswamy, 1982; Subrahmanyam, 2010).

To validate the CAPM it is tested the intercept of the linear regression:

Null Hypothesis → $\mathbf{H_0: \alpha_i = 0}$

Alternative Hypothesis → $\mathbf{H_1: \alpha_i \neq 0}$

If the null hypothesis is satisfied, therefore the model in explained only by the systematic risk, and the relationship is positive and linear. However, the model is not significant as F > 0.05 (F = 0.25). Though, looking at the intercept, the value is not so far from zero ($\alpha_i$ = 0.009) and, even if it is still not significant (p-value = 0.08), there is a quasi-relationship between the dependent variable, represented by excess returns, and the independent variable, the systematic risk beta.

What emerges from the first period of time analysed is that the CAPM is not valid from 2001 to 2006, as it is not able to explain the relationship between risk and returns, in fact, despite the linearity and positivity, the t-test is not significant. It is arguable that during this period of time, the Irish market had a little influence on explaining the stock returns.

The second linear regression, which analyses the period of time 2007-2008, shows a strength of correlation that suggests some co-movement between returns and risk (R = 48%) and the explanatory power is significantly higher than the pre-crisis period ($R^2$ = 23%) even if it is still low for validating the model.

However, the significance of the modelled relationship is confirmed (F = 0.03, F < 0.05), and the coefficient shows significance as well (p-value = 0.03), but the null hypothesis of the intercept is rejected, even if $\alpha_i$ = 0.008, as its p-value exceeds 0.05 (p-value = 0.3).

It seems the influence of the crisis is noteworthy: even if the model is not validated,

it is noticeable that the behaviour of the market in times of crisis affects the trend of the returns.

The third linear regression analyses the relationship risk-returns in the post-crisis periods (2009-2011) and it shows a similar result sought in the pre-crisis phase: the correlation coefficient is weak and positive (R = 40%) and the explanatory power of the independent variable is lower than during the crisis ($R^2$ = 16%) but greater than the first regression observed. The regression is significant (F = 0.03) but the model is rejected due to the insignificance of the intercept ($\alpha_i$ = - 0.007; p-value = 0.11).

Furthermore, the coefficient highlights the existence of a negative, but linear relationship risk-return, whereas in the two precedent phases (pre-crisis and crisis) the relationship is positive.

Several empirical attempts have tried to validate the CAPM, even if poor attention has been paid with reference to the Irish market and the global financial crisis. The next chapter will discuss about the literature related to the findings of this study.

## Chapter 4. Discussion

The study finds that the CAPM is not a good indicator for asset returns at ISE as the model is non-statistically significant for all the three period of time considered. However, what emerges is a greater, but still not significant, explanatory power of the systematic risk on the required return on assets during the global financial crisis, whereas pre and post-crisis the $R^2$ is lower (2001-2006: $R^2$ = 23%; 2009-2011: $R^2$ = 16%).

The analysis of the three linear regressions does not support the Capital Asset Pricing Model's theory developed by Sharpe (1964), Lintner (1965) and Mossin (1966) where the relationship between the excess returns and the systemic risk should be linear and positive, as the returns on the assets should be only explained by the factor β. Thus, the above results express support to the Basu and Chawla (2010) study based on the Indian market: the CAPM is invalidated as it fails to explain excess returns, due to R-coefficient extremely low and the absence of

significance of the intercept, and to the UK study of Hwang, Gao and Howen (2012), who reject the model because the systematic risk is not enough in explaining the returns; other factors have to be comprise to validate the CAPM.

The model developed does not support the findings of Lee, Cheng and Chong (2016) based at Malaysian Stock Exchange, where the CAPM is validated by applying the same methodology.

Bearing in mind the limitations of the methodology pursued and data utilised in the analysis, as discussed in the previous section (2.4), the results indicate other factors may be at play at Irish Stock Exchange as beta does not seems an appropriate explanatory measure.

Though, the analysis shows that there is a different pattern for the period pre, during and post the financial crisis: it is possible to think of those three stages as the periods where, respectively, there was no strict policy, a rigorous policy and a return in a less cautious behaviour. When the market is experiencing a downturn the CAPM seems more efficient in capturing the co-movement between risk and returns, albeit the model is still statistically non-significant.

According to Pettengill et al. (1995) and Bilić, Dimitrić and Škalamera-Aliović (2016) the crisis' influence should validate the Capital Asset Pricing Model the more the distance from the crisis is longer in terms of time; however, it is arguable that in the Irish context, the opposite occurs: during the pre-crisis period, the market was characterized by a less rigour in policies and discipline and investors were more willing to take risks, the CAPM, even if is still statistically non-significant highlights a positive relationship between the variables observed and an intercept that is almost zero and almost significant ($\alpha_i = 0.009$; p-value = 0.08); during the crisis, and the immediate intervention of EU and the rigorous policy developed to establish stability in the financial system, the model seems acquiring more validity as the explanatory power of the systemic risk on the excess returns is greater than the other two stages; whereas, in the sub-period of the post-crisis, the relationship between risk and returns becomes negative and non-significant, with a lower explanatory power ($R^2 = 16\%$).

In those circumstances, the CAPM gives an understanding of market behaviour, however, according to Cai, Clacher and Keasey (2013) the model limits the

comprehension of the market itself with its idealistic assumption based on a perfect behaviour rather than the reality of the facts. Indeed, it is assumed rationality in human being and, consequently, in the market.

During the global financial crisis individuals, governments and institutions behaved non-rationally taking too much risk, believing that the market was efficient and would have restored the stability (auto-correction); this behaviour led to a systemic collapse fostered by the weaknesses of the regulations.

The study suggests to examine market behaviours and expand the CAPM model to other factors, considering a relaxation of its assumptions, which, as evident, are a limitation of the model itself.

Furthermore, when considering the valuation of a business the systemic risk has not to be the only element observed. In the aftermath of the 2008 it is essential to assess the systemic importance in the whole financial system, taking in consideration the effect of its downturn, as it causes risk spill over and externalities that are borne by the whole economy.

## Chapter 5. Conclusion

This study set out to test the validity of the Capital Asset Pricing Model within the Irish Stock Exchange. Specifically, the research investigated the risk-return linear and positive relationship predicted by the theory. The findings from this study indicate that the model fails in explaining the co-movement of the two variables, suggesting that more than one factor may be necessary to explain the asset pricing.

To test the traditional CAPM, which states that only one factor, the systematic risk beta, influences the required return on asset and their relationship is positive and linear, the stocks traded at ISE for the period of time 2001-2011 were used. The data was divided into three sub-periods, in order to assess the performance of the CAPM before, during and after the global financial crisis; 25 listed companies out of 55 (due to unavailability of data for the period specified), have been allocated in 110 portfolios (semi-annually constructed) in descending order of beta, which has been estimated, due to the unavailability of the real data. Three linear regressions and t-test of the intercepts have been carried out in relation to the sub-periods.

The methodology pursued to address the research question follows the statistical

approach of Fama and MacBeth (1973); Basu and Chawla (2010); Hwang, Gao and Owen (2012); Lee, Cheng and Chong (2016) who tested the model through a linear regression and a t-test of the intercept, paying attention to the systematic risk beta as the only factor which affects the required return on assets in a portfolio.

Within this study, non-significance emerges in all the three sub-periods analysed: non-zero intercepts and weak relationships between risk and returns determine the fallacy of the CAPM in explaining the asset prices at ISE. The methodology applied and the findings are in line with the study of Basu and Chawla (2010) who examined the CAPM at Indian Stock Exchange, and the study of Hwang, Gao and Howen (2012), who rejected the model within the UK market. Though, the model does not support the findings of Lee, Cheng and Chong (2016), at Malaysian Stock Exchange, where the CAPM is significant. Furthermore, the relationship appears to be negative in the period immediately after the global financial crisis (2009-2011), contrasting partially the work of Pettengill et al. (1995) who found that in bearish market the relationship risk-return is negative and in bullish is positive and Bilić, Dimitrić and Škalamera-Aliović (2016) research that affirmed the validation of CAPM when the distance from the crisis is longer in terms of time. The irrelevance of the model indicates that other variables should be included as other empirical evidences suggest (Fama and French, 1992).

Despite the non-significance of the CAPM, the sub-period 2007-2008, which analyses the performance of the model during the financial crisis, shows a greater co-movement risk-return and more powerful explanatory power of the risk in clarifying the returns ($R = 48\%$; $R^2 = 23\%$), compared to the other two sub-periods (2001-2006: $R = 15\%$, $R^2 = 2.26\%$; 2009-2011: $R = 40$, $R^2 = 16\%$).

What emerged from the study is that there is a difference in behaviour pre, during and post-crisis: the CAPM seems more “efficient” in periods of downturn, where market policies are stricter. In fact, whilst in pre-crisis the correlation and $R^2$ coefficient are extremely low, during the financial crisis they tend to be higher, and then falling again post-crisis, in a more moderate way, showing a downward trend. This behaviour contrasts the findings of Pettengill at al. (1995) who tested the model in up and down market periods, finding that the risk-return relationship is positive in bearish market and negative in bullish market: in this circumstances a bearish

market, characterised by the global financial crisis established a positive and stronger relationship, but non-significant, between the systematic risk and the required return on assets for efficient portfolios. Also, the crisis should have a greater influence in the validation of the model as the distance in terms of time increases (Bilić, Dimitrić and Škalamera-Aliović, 2016) but in the case of the Irish market, the more the distance from the crisis the less "effective" the CAPM appears, in fact the relationship risk-returns is negative and weaker.

The study has been performed keeping in mind the limitations of the procedures adopted: the estimations of beta produced anomalies in the outcomes due to events occurred in those years (reverse stock splits, losses, falling in stock prices as consequences of the crisis) which lead to disproportionate values; the theoretical assumptions of the CAPM do not match with real world; the period of time analysed did not allow to gather the stock returns for all the 55 companies listed at ISE; the empirical suggestions of the multi-factors' influence in explaining asset returns. Additionally, according to Basu and Chawla (2010), the failure of the CAPM can be attributed to other factors and limitations of the methodology pursued: tax effects, imperfect market proxy, borrowing and lending at different tax rates, dividends, etc. In fact, in absence of borrowing and lending at risk free rate the returns on asset will be explained by two factors: beta and the market factor (Black, 1970), whereas empirical evidences (Black and Scholes, 1970) reject the influence of dividends.

The Capital Asset Pricing Model fails at ISE for the reason that the systematic risk is not sufficient, as unique factor, in explaining the asset returns; though, despite the non-significance of the model the beta factor has a noteworthy role, especially during the crisis (2007-2008), where the explanatory power is greater, but still non-significant.

It is concluded that the CAPM is not an adequate measure for the Irish Stock Exchange and that its validity is rejected for all three sub-periods examined: non-zero intercepts (even if very close to zero during the pre-crisis, $\alpha_i = 0.009$; p-value = 0.08) and statistically non-significance characterised the analysis. It is possible to observe a trend in the explanatory power of the systematic risk on the asset returns during the crisis, which declines immediately after, meaning that in periods of

stricter policies and downturn, the systematic risk acquires more efficiency in influencing the asset returns.

Even though the above-mentioned results indicate the failure of the CAPM at Irish Stock Exchange, further researches could be attempted to validate the model at the Irish market by introducing multi-factors to explain the missing elements in determining the asset returns; other asset pricing models could be applied in order to perform a comparative study which cover the shortcomings of the CAPM's theory. Also, an extended period of time and a more exhaustive and sophisticated market proxy could be contemplated in the analysis.

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# Appendix A

**Table 1: Semi-annual Beta Estimations.**

| COMPANY | BETA 1 -2001 | BETA 2 -2001 | BETA 1 -2002 | BETA 2 -2002 | BETA 1 -2003 | BETA 2 -2003 | BETA 1 -2004 | BETA 2 -2004 | BETA 1 -2005 | BETA 2 -2005 | BETA 1 -2006 | BETA 2 -2006 | BETA 1 -2007 | BETA 2 -2007 | BETA 1 -2008 | BETA 2 -2008 | BETA 1 -2009 | BETA 2 -2009 | BETA 1 -2010 | BETA 2 -2010 | BETA 1 -2011 | BETA 2 -2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALLIED IRISH BANKS | 0.830277787 | 0.634815224 | 0.051385719 | -0.17428476 | 0.013569101 | -0.0296697 | 0.882818361 | 0.402133571 | 0.525534985 | 0.887537974 | 1.099078533 | 1.376362411 | 1.02101116 | 1.367038789 | 1.073090379 | 1.585156866 | 4.828825613 | 2.108370405 | 2.710195283 | 1.416900285 | 3.675224622 | 2.500548361 |
| CRH | 0.56378546 | 0.728590691 | -0.01253927 | 0.722034298 | -0.00883602 | -0.02594216 | 0.877361667 | 0.927674958 | 0.830922211 | 1.671139386 | 1.545455698 | 1.436606293 | 1.089564248 | 1.131356784 | 0.763009997 | 0.961421369 | 0.917752494 | 0.991932438 | 1.023214526 | 1.865363543 | 1.337391499 | 1.444605039 |
| BANK OF IRELAND | 1.339230648 | 0.568644624 | 0.021463271 | -0.31410461 | 0.004294465 | -0.02190122 | 0.939912675 | 1.12227091 | 0.319505757 | 0.939290006 | 0.672975796 | 0.812757112 | 1.131936985 | 1.315731774 | 1.260025469 | 1.975901287 | 4.763236159 | 2.67607551 | 2.803298038 | 2.414794986 | 1.109574307 | 1.306114062 |
| TULLOW OIL | 0.737534934 | 0.013568946 | 0.014172236 | 0.07022452 | 0.002907572 | -0.0343558 | 0.753615196 | 0.423963497 | 0.00337417 | 0.738484856 | 1.666087033 | 0.569336751 | 1.211422154 | 0.444840847 | 0.36764858 | 0.642593488 | 0.75109099 | 0.366652842 | 1.249396835 | 0.774204477 | 0.524847095 | 1.115619558 |
| PERMANENT TSB | 0.848546405 | 0.790689793 | 0.003924534 | 1.146653276 | -0.01077723 | -0.02604187 | 0.7508447 | 0.522712514 | 0.63180354 | 1.090736489 | 1.001139322 | 1.188384695 | 1.11576433 | 1.490740825 | 1.163359476 | 1.812771821 | 2.629772929 | 1.214923662 | 1.597498346 | 1.457573353 | -0.92716821 | 1.08730563 |
| ORMONDE MINING | -0.260471743 | -0.09536036 | 0.012837773 | -0.04303065 | 0.058580679 | 0.041987637 | 1.177128298 | 0.143523868 | 7.65552E-05 | 1.196212795 | 1.396582006 | 0.901310693 | -0.44593261 | 0.712316166 | 0.020123 | 0.310603108 | 0.309893382 | 0.035396924 | 0.830537718 | -0.33834583 | 0.912037203 | 0.909745541 |
| KINGSPAN GROUP | 1.12272775 | 0.472832219 | -0.06103811 | 1.057863678 | -0.15318278 | 0.023724163 | 0.398841906 | 0.851031236 | 0.407170632 | 1.062910808 | 1.201833147 | 0.941800943 | 1.007796936 | 1.42320117 | 0.853855558 | 1.276900392 | 1.191997147 | 0.988086296 | 0.654289664 | 1.372716758 | 0.62738054 | 0.885115117 |
| KENMARE RESOURCES | 0.494156155 | 0.319722535 | 0.003486631 | 0.532523694 | 0.005389517 | 0.01382958 | 0.757417385 | 1.455482004 | 6.670664158 | 3.164907889 | 7.853359633 | -6.03798626 | 1.243857348 | 5.402127222 | -1.45749325 | -0.69523297 | -0.88938322 | -1.86330949 | 1.106854777 | -0.34302329 | -0.55696549 | 0.869649331 |
| RYANAIR HOLDINGS | 1.648764373 | 1.623630375 | -0.07555758 | 1.817193483 | 0.01129598 | 0.01787228 | 3.004528009 | 2.802326883 | 1.013074633 | 0.805012015 | 0.079721756 | 0.519909015 | 2.603307338 | 0.738193264 | 1.448140023 | 1.038566035 | 0.654788531 | 0.917249059 | 0.875564993 | 0.256531825 | 1.056214135 | 0.850306751 |
| KERRY GROUP | 0.269566903 | 0.265487264 | -0.02430506 | 0.260034949 | -0.02349291 | -0.03534523 | 0.172710659 | 0.26785349 | 0.306757397 | 0.541523034 | 0.989952376 | 0.492870778 | 0.260824255 | 0.431248173 | 0.640019441 | 0.135877194 | 0.48009816 | 0.120184145 | 0.569675302 | 0.180840851 | 0.568377844 | 0.760502765 |
| PADDY POWER BETFAIR | 0.344683614 | 0.638559568 | -0.04416546 | 0.458848819 | -0.01539607 | 0.010286715 | 0.372531472 | 0.257000807 | -0.11455545 | -0.15936579 | 1.910374668 | 1.263409563 | 1.045007638 | 0.578746053 | 0.114201194 | 0.74299738 | 0.625164644 | 0.476398379 | 0.520727188 | 0.753629366 | 0.383738212 | 0.742823216 |
| OVOCA GOLD | -0.150971807 | 0.092835835 | 0.060360967 | -1.81527809 | 0.003516384 | 0.217700098 | 1.057707155 | 1.020886644 | 0.077807391 | -1.26280936 | 0.156824211 | 0.813905024 | -0.27618854 | -0.02242092 | 1.020855954 | 0.412695316 | -0.33222191 | -0.35025046 | -7.66496845 | 0.395680411 | 0.729420084 | 0.718595139 |
| AMINEX | 1.062148665 | 0.177646739 | -0.01583723 | -0.05009923 | 0.029315833 | -0.0060485 | -1.07690966 | -0.15709895 | 1.10536051 | -1.05343014 | 1.551648347 | 0.806902784 | 1.230196158 | 0.490475589 | -0.08565319 | 0.430563477 | 0.896893973 | -0.16910334 | 0.66456309 | -0.60393551 | -0.08351108 | 0.703563189 |
| PROVIDENCE RESOURCES | 1.485665546 | -0.22884345 | -0.41183508 | 0.167062479 | -0.17617344 | 0.00883658 | 1.698749216 | -0.97441994 | 2.054989277 | 0.769334315 | 1.267967225 | 1.170856305 | -0.2598543 | 0.235291422 | 0.241828766 | 0.459232633 | 0.346757424 | -0.16199401 | 139.3489157 | 0.123983747 | -0.95050151 | 0.592011639 |
| DONEGAL INVESTMENT GROUP | -0.20367472 | -0.07988064 | -0.02527501 | 0.123783813 | 0.05781679 | 0.002748954 | 0.534175862 | 0.209810088 | 0.20641371 | -0.14399527 | 0.33874542 | -0.69166127 | -0.08701613 | -0.11775067 | -0.01658291 | 0.106945566 | 0.227309485 | 0.286438899 | -0.22285167 | -0.41617841 | -0.08684526 | 0.540880116 |
| GLANBIA | 0.864116486 | 0.497133695 | -0.0328239 | 0.313331831 | -0.00091926 | 0.028446222 | 0.87148745 | 0.444740496 | 0.948069763 | 1.248690816 | 0.783443537 | 0.70613953 | 0.252956591 | 0.251872235 | -0.10338754 | 0.443949642 | 0.722540684 | 0.409058403 | 0.671036098 | 0.181894954 | 0.564108145 | 0.481760836 |
| FBD HOLDINGS | -0.108409935 | 0.471409141 | 0.027191169 | -0.13244385 | -0.00439253 | 0.007031802 | 0.024055655 | -0.10929321 | 0.350370071 | 0.36096778 | 0.479862304 | 0.638623821 | 0.833064041 | 0.967946381 | 0.06051433 | 0.817232941 | 0.604526762 | 0.588294919 | 0.966542484 | 0.17825244 | 0.098393293 | 0.3775373 |
| DATALEX | 0.843500707 | 0.724173413 | -0.12537741 | 0.964311057 | 0.00267883 | -0.10451122 | -1.29774157 | -0.75143894 | 0.742044562 | -0.09270508 | 0.415335875 | -0.13233702 | 0.373779857 | 0.511116855 | -0.02273003 | 0.259198018 | 0.358459537 | 0.901745716 | 1.131393604 | 0.144854945 | -0.76689782 | 0.257342458 |
| IRISH CONTINENTAL GROUP | -0.170084452 | 0.885223096 | 0.006075067 | 0.563638061 | -0.0091904 | -0.04138397 | 0.503040352 | 0.998927294 | 0.507993441 | 0.761543351 | 0.271977175 | 1.046204617 | 0.396158763 | 0.249249082 | 0.436030395 | -0.0212696 | 0.260652291 | -0.0004672 | 0.381938905 | 0.168114346 | 0.15719984 | 0.193169888 |
| IFG GROUP | 0.483637141 | 0.259734099 | -0.06101074 | 0.453545307 | 0.200016697 | 0.08160544 | 1.893321227 | 0.870662208 | 0.461536181 | 0.835564376 | 1.513062553 | 0.100073696 | 0.758391149 | 0.456411854 | 0.240668567 | 0.515380619 | 1.043916022 | 0.400312376 | 0.339018798 | 0.102789491 | -0.10365676 | 0.139384563 |
| INDEPENT NEWS&MEDIA | 0.235759336 | 1.05104699 | -0.03841533 | 0.262733097 | -0.09523061 | 0.055586499 | 0.714146643 | 0.367892541 | 0.482180432 | 0.61639016 | 0.730765281 | 0.800157447 | 0.735118326 | 0.603879199 | 1.085328073 | 1.38087934 | 2.350094297 | -22.7297741 | -0.38884174 | 6.109793894 | -0.23196138 | 0.043449231 |
| DIAGEO | -0.189640113 | 0.069645148 | 0.008875709 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TESCO PLC | 0.538018763 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ABBEY | -0.068584646 | 0.127756114 | 0.012472446 | -0.01883288 | -0.05219611 | 0.013338653 | 1.324439958 | 0.082240435 | 0.482684896 | 0.222720375 | 0.543324496 | 0.725370829 | 0.116949595 | 0.456828861 | 0.720735505 | 0.239202646 | 0.183414008 | 0.239792579 | -9.91000987 | 0.48716477 | 0.144497055 | -0.05458582 |
| CPL RESOURCES | 1.350033648 | -0.95109986 | -0.00942594 | -0.21511288 | 0.005509929 | -0.07587478 | 2.813831057 | 0.898207052 | 0.538420067 | 0.530593932 | 0.573585254 | 0.1970803 | 0.676189824 | 0.745115725 | 0.292787777 | 0.365724514 | 0.373428618 | 0.539989488 | 0.27561819 | 0.106096482 | -0.01560885 | -0.12859403 |

**Table 2: Semi-annual Portfolios construction 2001.**

**1st SEMESTER 2001**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 1 | RYANAIR HOLDINGS | 1.648764 |
| | PROVIDENCE RESOURCES | 1.485666 |
| | CPL RESOURCES | 1.350034 |
| | BANK OF IRELAND | 1.339231 |
| | KINGSPAN GROUP | 1.122728 |
| | **BETA PORTFOLIO 1** | **1.389284** |
| | **RETURN** | **-0.00199** |
| | **STD.DEV** | **0.052706** |
| 2 | AMINEX | 1.062149 |
| | GLANBIA | 0.864116 |
| | PERMANENT TSB | 0.848546 |
| | DATALEX | 0.843501 |
| | ALLIED IRISH BANKS | 0.830278 |
| | **BETA PORTFOLIO 2** | **0.889718** |
| | **RETURN** | **-0.00112** |
| | **STD.DEV** | **0.042336** |
| 3 | TULLOW OIL | 0.737535 |
| | CRH | 0.563785 |
| | TESCO PLC | 0.538019 |
| | KENMARE RESOURCES | 0.494156 |
| | IFG GROUP | 0.483637 |
| | **BETA PORTFOLIO 3** | **0.563426** |
| | **RETURN** | **0.012654** |
| | **STD.DEV** | **0.028501** |
| 4 | PADDY POWER BETFAIR | 0.344684 |
| | KERRY GROUP | 0.269567 |
| | INDEPENT NEWS&MEDIA | 0.235759 |
| | ABBEY | -0.06858 |
| | FBD HOLDINGS | -0.10841 |
| | **BETA PORTFOLIO 4** | **0.134603** |
| | **RETURN** | **0.001034** |
| | **STD.DEV** | **0.01968** |
| 5 | OVOCA GOLD | -0.15097 |
| | IRISH CONTINENTAL GROUP | -0.17008 |
| | DIAGEO | -0.18964 |
| | DONEGAL INVESTMENT GROUP | -0.20367 |
| | ORMONDE MINING | -0.26047 |
| | **BETA PORTFOLIO 5** | **-0.19497** |
| | **RETURN** | **0.008964** |
| | **STD.DEV** | **0.042745** |

**2nd SEMESTER 2001**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 6 | RYANAIR HOLDINGS | 1.62363 |
| | INDEPENT NEWS&MEDIA | 1.051047 |
| | IRISH CONTINENTAL GROUP | 0.885223 |
| | PERMANENT TSB | 0.79069 |
| | CRH | 0.728591 |
| | **BETA PORTFOLIO 6** | **1.015836** |
| | **RETURN** | **-0.00253** |
| | **STD.DEV** | **0.040015** |
| 7 | DATALEX | 0.724173 |
| | PADDY POWER BETFAIR | 0.63856 |
| | ALLIED IRISH BANKS | 0.634815 |
| | BANK OF IRELAND | 0.568645 |
| | GLANBIA | 0.497134 |
| | **BETA PORTFOLIO 7** | **0.612665** |
| | **RETURN** | **-0.00858** |
| | **STD.DEV** | **0.038721** |
| 8 | KINGSPAN GROUP | 0.472832 |
| | FBD HOLDINGS | 0.471409 |
| | KENMARE RESOURCES | 0.319723 |
| | KERRY GROUP | 0.265487 |
| | IFG GROUP | 0.259734 |
| | **BETA PORTFOLIO 8** | **0.357837** |
| | **RETURN** | **-0.00181** |
| | **STD.DEV** | **0.025708** |
| 9 | AMINEX | 0.177647 |
| | ABBEY | 0.127756 |
| | OVOCA GOLD | 0.092836 |
| | DIAGEO | 0.069645 |
| | TULLOW OIL | 0.013569 |
| | **BETA PORTFOLIO 9** | **0.096291** |
| | **RETURN** | **-0.00532** |
| | **STD.DEV** | **0.036507** |
| 10 | TESCO PLC | 0 |
| | DONEGAL INVESTMENT GROUP | -0.07988 |
| | ORMONDE MINING | -0.09536 |
| | PROVIDENCE RESOURCES | -0.22884 |
| | CPL RESOURCES | -0.9511 |
| | **BETA PORTFOLIO 10** | **-0.27104** |
| | **RETURN** | **-0.00524** |
| | **STD.DEV** | **0.028718** |

**Table 3: Semi-annual Portfolios construction 2002.**

**1st SEMESTER 2002**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 11 | OVOCA GOLD | 0.060361 |
| | ALLIED IRISH BANKS | 0.051386 |
| | FBD HOLDINGS | 0.027191 |
| | BANK OF IRELAND | 0.021463 |
| | TULLOW OIL | 0.014172 |
| | **BETA PORTFOLIO 11** | **0.034915** |
| | **RETURN** | **0.013319** |
| | **STD.DEV** | **0.052944** |
| 12 | ORMONDE MINING | 0.012838 |
| | ABBEY | 0.012472 |
| | DIAGEO | 0.008876 |
| | IRISH CONTINENTAL GROUP | 0.006075 |
| | PERMANENT TSB | 0.003925 |
| | **BETA PORTFOLIO 12** | **0.008837** |
| | **RETURN** | **0.009414** |
| | **STD.DEV** | **0.025379** |
| 13 | KENMARE RESOURCES | 0.003487 |
| | TESCO PLC | 0 |
| | CPL RESOURCES | -0.00943 |
| | CRH | -0.01254 |
| | AMINEX | -0.01584 |
| | **BETA PORTFOLIO 13** | **-0.00686** |
| | **RETURN** | **0.002112** |
| | **STD.DEV** | **0.037281** |
| 14 | KERRY GROUP | -0.02431 |
| | DONEGAL INVESTMENT GROUP | -0.02528 |
| | GLANBIA | -0.03282 |
| | INDEPENT NEWS&MEDIA | -0.03842 |
| | PADDY POWER BETFAIR | -0.04417 |
| | **BETA PORTFOLIO 14** | **-0.033** |
| | **RETURN** | **0.005175** |
| | **STD.DEV** | **0.019929** |
| 15 | IFG GROUP | -0.06101 |
| | KINGSPAN GROUP | -0.06104 |
| | RYANAIR HOLDINGS | -0.07556 |
| | DATALEX | -0.12538 |
| | PROVIDENCE RESOURCES | -0.41184 |
| | **BETA PORTFOLIO 15** | **-0.14696** |
| | **RETURN** | **-0.00334** |
| | **STD.DEV** | **0.044888** |

**2nd SEMESTER 2002**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 16 | RYANAIR HOLDINGS | 1.817193 |
| | PERMANENT TSB | 1.146653 |
| | KINGSPAN GROUP | 1.057864 |
| | DATALEX | 0.964311 |
| | CRH | 0.722034 |
| | **BETA PORTFOLIO 16** | **1.141611** |
| | **RETURN** | **-0.00316** |
| | **STD.DEV** | **0.059484** |
| 17 | IRISH CONTINENTAL GROUP | 0.563638 |
| | KENMARE RESOURCES | 0.532524 |
| | PADDY POWER BETFAIR | 0.458849 |
| | IFG GROUP | 0.453545 |
| | GLANBIA | 0.313332 |
| | **BETA PORTFOLIO 17** | **0.464378** |
| | **RETURN** | **-0.01805** |
| | **STD.DEV** | **0.03686** |
| 18 | INDEPENT NEWS&MEDIA | 0.262733 |
| | KERRY GROUP | 0.260035 |
| | PROVIDENCE RESOURCES | 0.167062 |
| | DONEGAL INVESTMENT GROUP | 0.123784 |
| | TULLOW OIL | 0.070225 |
| | **BETA PORTFOLIO 18** | **0.176768** |
| | **RETURN** | **-0.00111** |
| | **STD.DEV** | **0.040003** |
| 19 | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | ABBEY | -0.01883 |
| | ORMONDE MINING | -0.04303 |
| | AMINEX | -0.0501 |
| | **BETA PORTFOLIO 19** | **-0.02239** |
| | **RETURN** | **-0.00577** |
| | **STD.DEV** | **0.017356** |
| 20 | FBD HOLDINGS | -0.13244 |
| | ALLIED IRISH BANKS | -0.17428 |
| | CPL RESOURCES | -0.21511 |
| | BANK OF IRELAND | -0.3141 |
| | OVOCA GOLD | -1.81528 |
| | **BETA PORTFOLIO 20** | **-0.53024** |
| | **RETURN** | **0.00427** |
| | **STD.DEV** | **0.050329** |

**Table 4: Semi-annual Portfolios construction 2003.**

**1st SEMESTER 2003**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 21 | IFG GROUP | 0.200017 |
| | ORMONDE MINING | 0.058581 |
| | DONEGAL INVESTMENT GROUP | 0.057817 |
| | AMINEX | 0.029316 |
| | ALLIED IRISH BANKS | 0.013569 |
| | **BETA PORTFOLIO 21** | **0.07186** |
| | **RETURN** | **0.009506** |
| | **STD.DEV** | **0.037225** |
| 22 | RYANAIR HOLDINGS | 0.011296 |
| | CPL RESOURCES | 0.00551 |
| | KENMARE RESOURCES | 0.00539 |
| | BANK OF IRELAND | 0.004294 |
| | OVOCA GOLD | 0.003516 |
| | **BETA PORTFOLIO 22** | **0.006001** |
| | **RETURN** | **0.002167** |
| | **STD.DEV** | **0.041658** |
| 23 | TULLOW OIL | 0.002908 |
| | DATALEX | 0.002679 |
| | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | GLANBIA | -0.00092 |
| | **BETA PORTFOLIO 23** | **0.000933** |
| | **RETURN** | **0.00099** |
| | **STD.DEV** | **0.027087** |
| 24 | FBD HOLDINGS | -0.00439 |
| | CRH | -0.00884 |
| | IRISH CONTINENTAL GROUP | -0.00919 |
| | PERMANENT TSB | -0.01078 |
| | PADDY POWER BETFAIR | -0.0154 |
| | **BETA PORTFOLIO 24** | **-0.00972** |
| | **RETURN** | **0.003453** |
| | **STD.DEV** | **0.018649** |
| 25 | KERRY GROUP | -0.02349 |
| | ABBEY | -0.0522 |
| | INDEPENT NEWS&MEDIA | -0.09523 |
| | KINGSPAN GROUP | -0.15318 |
| | PROVIDENCE RESOURCES | -0.17617 |
| | **BETA PORTFOLIO 25** | **-0.10006** |
| | **RETURN** | **0.012343** |
| | **STD.DEV** | **0.047733** |

**2nd SEMESTER 2003**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 26 | OVOCA GOLD | 0.2177 |
| | IFG GROUP | 0.081605 |
| | INDEPENT NEWS&MEDIA | 0.055586 |
| | ORMONDE MINING | 0.041988 |
| | GLANBIA | 0.028446 |
| | **BETA PORTFOLIO 26** | **0.085065** |
| | **RETURN** | **0.012902** |
| | **STD.DEV** | **0.053124** |
| 27 | KINGSPAN GROUP | 0.023724 |
| | RYANAIR HOLDINGS | 0.017872 |
| | KENMARE RESOURCES | 0.01383 |
| | ABBEY | 0.013339 |
| | PADDY POWER BETFAIR | 0.010287 |
| | **BETA PORTFOLIO 27** | **0.01581** |
| | **RETURN** | **0.009951** |
| | **STD.DEV** | **0.021568** |
| 28 | PROVIDENCE RESOURCES | 0.008837 |
| | FBD HOLDINGS | 0.007032 |
| | DONEGAL INVESTMENT GROUP | 0.002749 |
| | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | **BETA PORTFOLIO 28** | **0.003723** |
| | **RETURN** | **0.016802** |
| | **STD.DEV** | **0.056996** |
| 29 | AMINEX | -0.00605 |
| | BANK OF IRELAND | -0.0219 |
| | CRH | -0.02594 |
| | PERMANENT TSB | -0.02604 |
| | ALLIED IRISH BANKS | -0.02967 |
| | **BETA PORTFOLIO 29** | **-0.02192** |
| | **RETURN** | **0.00381** |
| | **STD.DEV** | **0.023849** |
| 30 | TULLOW OIL | -0.03436 |
| | KERRY GROUP | -0.03535 |
| | IRISH CONTINENTAL GROUP | -0.04138 |
| | CPL RESOURCES | -0.07587 |
| | DATALEX | -0.10451 |
| | **BETA PORTFOLIO 30** | **-0.05829** |
| | **RETURN** | **0.012175** |
| | **STD.DEV** | **0.035704** |

**Table 5: Semi-annual Portfolios construction 2004.**

**1st SEMESTER 2004**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 31 | RYANAIR HOLDINGS | 3.004528 |
| | CPL RESOURCES | 2.813831 |
| | IFG GROUP | 1.893321 |
| | PROVIDENCE RESOURCES | 1.698749 |
| | ABBEY | 1.32444 |
| | **BETA PORTFOLIO 31** | **2.146974** |
| | **RETURN** | **0.010677** |
| | **STD.DEV** | **0.054408** |
| 32 | ORMONDE MINING | 1.177128 |
| | OVOCA GOLD | 1.057707 |
| | BANK OF IRELAND | 0.939913 |
| | ALLIED IRISH BANKS | 0.882818 |
| | CRH | 0.877362 |
| | **BETA PORTFOLIO 32** | **0.986986** |
| | **RETURN** | **0.010151** |
| | **STD.DEV** | **0.036018** |
| 33 | GLANBIA | 0.871487 |
| | KENMARE RESOURCES | 0.757417 |
| | TULLOW OIL | 0.753615 |
| | PERMANENT TSB | 0.750845 |
| | INDEPENT NEWS&MEDIA | 0.714147 |
| | **BETA PORTFOLIO 33** | **0.769502** |
| | **RETURN** | **0.007055** |
| | **STD.DEV** | **0.024045** |
| 34 | DONEGAL INVESTMENT GROUP | 0.534176 |
| | IRISH CONTINENTAL GROUP | 0.50304 |
| | KINGSPAN GROUP | 0.398842 |
| | PADDY POWER BETFAIR | 0.372531 |
| | KERRY GROUP | 0.172711 |
| | **BETA PORTFOLIO 34** | **0.39626** |
| | **RETURN** | **0.007099** |
| | **STD.DEV** | **0.015599** |
| 35 | FBD HOLDINGS | 0.024056 |
| | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | AMINEX | -1.07691 |
| | DATALEX | -1.29774 |
| | **BETA PORTFOLIO 35** | **-0.47012** |
| | **RETURN** | **-0.00597** |
| | **STD.DEV** | **0.025404** |

**2nd SEMESTER 2004**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 36 | RYANAIR HOLDINGS | 2.802327 |
| | KENMARE RESOURCES | 1.455482 |
| | BANK OF IRELAND | 1.122271 |
| | OVOCA GOLD | 1.020887 |
| | IRISH CONTINENTAL GROUP | 0.998927 |
| | **BETA PORTFOLIO 36** | **1.479979** |
| | **RETURN** | **0.13108** |
| | **STD.DEV** | **0.300411** |
| 37 | CRH | 0.927675 |
| | CPL RESOURCES | 0.898207 |
| | IFG GROUP | 0.870662 |
| | KINGSPAN GROUP | 0.851031 |
| | PERMANENT TSB | 0.522713 |
| | **BETA PORTFOLIO 37** | **0.814058** |
| | **RETURN** | **0.004426** |
| | **STD.DEV** | **0.01859** |
| 38 | GLANBIA | 0.44474 |
| | TULLOW OIL | 0.423963 |
| | ALLIED IRISH BANKS | 0.402134 |
| | INDEPENT NEWS&MEDIA | 0.367893 |
| | KERRY GROUP | 0.267853 |
| | **BETA PORTFOLIO 38** | **0.381317** |
| | **RETURN** | **0.004811** |
| | **STD.DEV** | **0.01275** |
| 39 | PADDY POWER BETFAIR | 0.257001 |
| | DONEGAL INVESTMENT GROUP | 0.20981 |
| | ORMONDE MINING | 0.143524 |
| | ABBEY | 0.08224 |
| | DIAGEO | 0 |
| | **BETA PORTFOLIO 39** | **0.138515** |
| | **RETURN** | **0.002729** |
| | **STD.DEV** | **0.014504** |
| 40 | TESCO PLC | 0 |
| | FBD HOLDINGS | -0.10929 |
| | AMINEX | -0.1571 |
| | DATALEX | -0.75144 |
| | PROVIDENCE RESOURCES | -0.97442 |
| | **BETA PORTFOLIO 40** | **-0.39845** |
| | **RETURN** | **-0.00028** |
| | **STD.DEV** | **0.044267** |

**Table 6: Semi-annual Portfolios construction 2005.**

**1st SEMESTER 2005**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 41 | KENMARE RESOURCES | 6.670664 |
| | PROVIDENCE RESOURCES | 2.054989 |
| | AMINEX | 1.105361 |
| | RYANAIR HOLDINGS | 1.013075 |
| | GLANBIA | 0.94807 |
| | **BETA PORTFOLIO 41** | **2.358432** |
| | **RETURN** | **0.127586** |
| | **STD.DEV** | **0.282962** |
| 42 | CRH | 0.830922 |
| | DATALEX | 0.742045 |
| | PERMANENT TSB | 0.631804 |
| | CPL RESOURCES | 0.53842 |
| | ALLIED IRISH BANKS | 0.525535 |
| | **BETA PORTFOLIO 42** | **0.653745** |
| | **RETURN** | **0.006663** |
| | **STD.DEV** | **0.020261** |
| 43 | IRISH CONTINENTAL GROUP | 0.507993 |
| | ABBEY | 0.482685 |
| | INDEPENT NEWS&MEDIA | 0.48218 |
| | IFG GROUP | 0.461536 |
| | KINGSPAN GROUP | 0.407171 |
| | **BETA PORTFOLIO 43** | **0.468313** |
| | **RETURN** | **0.005763** |
| | **STD.DEV** | **0.015903** |
| 44 | FBD HOLDINGS | 0.35037 |
| | BANK OF IRELAND | 0.319506 |
| | KERRY GROUP | 0.306757 |
| | DONEGAL INVESTMENT GROUP | 0.206414 |
| | OVOCA GOLD | 0.077807 |
| | **BETA PORTFOLIO 44** | **0.252171** |
| | **RETURN** | **0.008901** |
| | **STD.DEV** | **0.028805** |
| 45 | TULLOW OIL | 0.003374 |
| | ORMONDE MINING | 7.66E-05 |
| | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | PADDY POWER BETFAIR | -0.11456 |
| | **BETA PORTFOLIO 45** | **-0.02222** |
| | **RETURN** | **0.003492** |
| | **STD.DEV** | **0.018637** |

**2nd SEMESTER 2005**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 46 | KENMARE RESOURCES | 3.164907889 |
| | CRH | 1.671139386 |
| | GLANBIA | 1.248690816 |
| | ORMONDE MINING | 1.196212795 |
| | PERMANENT TSB | 1.090736489 |
| | **BETA PORTFOLIO 46** | **1.674337475** |
| | **RETURN** | **0.164744005** |
| | **STD.DEV** | **0.302959676** |
| 47 | KINGSPAN GROUP | 1.062910808 |
| | BANK OF IRELAND | 0.939290006 |
| | ALLIED IRISH BANKS | 0.887537974 |
| | IFG GROUP | 0.835564376 |
| | RYANAIR HOLDINGS | 0.805012015 |
| | **BETA PORTFOLIO 47** | **0.906063036** |
| | **RETURN** | **0.00601223** |
| | **STD.DEV** | **0.016719224** |
| 48 | PROVIDENCE RESOURCES | 0.769334315 |
| | IRISH CONTINENTAL GROUP | 0.761543351 |
| | TULLOW OIL | 0.738484856 |
| | INDEPENT NEWS&MEDIA | 0.61639016 |
| | KERRY GROUP | 0.541523034 |
| | **BETA PORTFOLIO 48** | **0.685455143** |
| | **RETURN** | **0.003126698** |
| | **STD.DEV** | **0.025456006** |
| 49 | CPL RESOURCES | 0.530593932 |
| | FBD HOLDINGS | 0.36096778 |
| | ABBEY | 0.222720375 |
| | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | **BETA PORTFOLIO 49** | **0.222856417** |
| | **RETURN** | **0.005574558** |
| | **STD.DEV** | **0.012904863** |
| 50 | DATALEX | -0.092705081 |
| | DONEGAL INVESTMENT GROUP | -0.143995271 |
| | PADDY POWER BETFAIR | -0.159365786 |
| | AMINEX | -1.053430145 |
| | OVOCA GOLD | -1.262809359 |
| | **BETA PORTFOLIO 50** | **-0.542461128** |
| | **RETURN** | **0.016849168** |
| | **STD.DEV** | **0.04345459** |

**Table 7: Semi-annual Portfolios construction 2006.**

**1st SEMESTER 2006**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 51 | KENMARE RESOURCES | 7.85336 |
| | PADDY POWER BETFAIR | 1.910375 |
| | TULLOW OIL | 1.666087 |
| | AMINEX | 1.551648 |
| | CRH | 1.545456 |
| | **BETA PORTFOLIO 51** | **2.905385** |
| | **RETURN** | **0.056583** |
| | **STD.DEV** | **0.174235** |
| 52 | IFG GROUP | 1.513063 |
| | ORMONDE MINING | 1.396582 |
| | PROVIDENCE RESOURCES | 1.267967 |
| | KINGSPAN GROUP | 1.201833 |
| | ALLIED IRISH BANKS | 1.099079 |
| | **BETA PORTFOLIO 52** | **1.295705** |
| | **RETURN** | **0.009139** |
| | **STD.DEV** | **0.038071** |
| 53 | PERMANENT TSB | 1.001139 |
| | KERRY GROUP | 0.989952 |
| | GLANBIA | 0.783444 |
| | INDEPENT NEWS&MEDIA | 0.730765 |
| | BANK OF IRELAND | 0.672976 |
| | **BETA PORTFOLIO 53** | **0.835655** |
| | **RETURN** | **-0.00085** |
| | **STD.DEV** | **0.021151** |
| 54 | CPL RESOURCES | 0.573585 |
| | ABBEY | 0.543324 |
| | FBD HOLDINGS | 0.479862 |
| | DATALEX | 0.415336 |
| | DONEGAL INVESTMENT GROUP | 0.338745 |
| | **BETA PORTFOLIO 54** | **0.470171** |
| | **RETURN** | **0.000925** |
| | **STD.DEV** | **0.020351** |
| 55 | IRISH CONTINENTAL GROUP | 0.271977 |
| | OVOCA GOLD | 0.156824 |
| | RYANAIR HOLDINGS | 0.079722 |
| | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | **BETA PORTFOLIO 55** | **0.101705** |
| | **RETURN** | **-0.00331** |
| | **STD.DEV** | **0.016843** |

**2nd SEMESTER 2006**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 56 | CRH | 1.436606 |
| | ALLIED IRISH BANKS | 1.376362 |
| | PADDY POWER BETFAIR | 1.26341 |
| | PERMANENT TSB | 1.188385 |
| | PROVIDENCE RESOURCES | 1.170856 |
| | **BETA PORTFOLIO 56** | **1.287124** |
| | **RETURN** | **0.006304** |
| | **STD.DEV** | **0.023258** |
| 57 | IRISH CONTINENTAL GROUP | 1.046205 |
| | KINGSPAN GROUP | 0.941801 |
| | ORMONDE MINING | 0.901311 |
| | OVOCA GOLD | 0.813905 |
| | BANK OF IRELAND | 0.812757 |
| | **BETA PORTFOLIO 57** | **0.903196** |
| | **RETURN** | **0.01219** |
| | **STD.DEV** | **0.025533** |
| 58 | AMINEX | 0.806903 |
| | INDEPENT NEWS&MEDIA | 0.800157 |
| | ABBEY | 0.725371 |
| | GLANBIA | 0.70614 |
| | FBD HOLDINGS | 0.638624 |
| | **BETA PORTFOLIO 58** | **0.735439** |
| | **RETURN** | **0.006547** |
| | **STD.DEV** | **0.018285** |
| 59 | TULLOW OIL | 0.569337 |
| | RYANAIR HOLDINGS | 0.519909 |
| | KERRY GROUP | 0.492871 |
| | CPL RESOURCES | 0.19708 |
| | IFG GROUP | 0.100074 |
| | **BETA PORTFOLIO 59** | **0.375854** |
| | **RETURN** | **0.010843** |
| | **STD.DEV** | **0.014787** |
| 60 | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | DATALEX | -0.13234 |
| | DONEGAL INVESTMENT GROUP | -0.69166 |
| | KENMARE RESOURCES | -6.03799 |
| | **BETA PORTFOLIO 60** | **-1.3724** |
| | **RETURN** | **0.039175** |
| | **STD.DEV** | **0.129219** |

**Table 8: Semi-annual Portfolios construction 2007.**

| 1st SEMESTER 2007 | | | 2nd SEMESTER 2007 | | |
|---|---|---|---|---|---|
| **PORTFOLIO** | **COMPANY** | **BETA** | **PORTFOLIO** | **COMPANY** | **BETA** |
| **61** | RYANAIR HOLDINGS | 2.603307 | **66** | KENMARE RESOURCES | 5.402127 |
| | KENMARE RESOURCES | 1.243857 | | PERMANENT TSB | 1.490741 |
| | AMINEX | 1.230196 | | KINGSPAN GROUP | 1.423201 |
| | TULLOW OIL | 1.211422 | | ALLIED IRISH BANKS | 1.367039 |
| | BANK OF IRELAND | 1.131937 | | BANK OF IRELAND | 1.315732 |
| | **BETA PORTFOLIO 61** | **1.484144** | | **BETA PORTFOLIO 66** | **2.199768** |
| | **RETURN** | **0.015246** | | **RETURN** | **0.018695** |
| | **STD.DEV** | **0.107283** | | **STD.DEV** | **0.135418** |
| **62** | PERMANENT TSB | 1.115764 | **67** | CRH | 1.131357 |
| | CRH | 1.089564 | | FBD HOLDINGS | 0.967946 |
| | PADDY POWER BETFAIR | 1.045008 | | CPL RESOURCES | 0.745116 |
| | ALLIED IRISH BANKS | 1.021011 | | RYANAIR HOLDINGS | 0.738193 |
| | KINGSPAN GROUP | 1.007797 | | ORMONDE MINING | 0.712316 |
| | **BETA PORTFOLIO 62** | **1.055829** | | **BETA PORTFOLIO 67** | **0.858986** |
| | **RETURN** | **0.002827** | | **RETURN** | **-0.00786** |
| | **STD.DEV** | **0.02915** | | **STD.DEV** | **0.046629** |
| **63** | FBD HOLDINGS | 0.833064 | **68** | INDEPENT NEWS&MEDIA | 0.603879 |
| | IFG GROUP | 0.758391 | | PADDY POWER BETFAIR | 0.578746 |
| | INDEPENT NEWS&MEDIA | 0.735118 | | DATALEX | 0.511117 |
| | CPL RESOURCES | 0.67619 | | AMINEX | 0.490476 |
| | IRISH CONTINENTAL GROUP | 0.396159 | | ABBEY | 0.456829 |
| | **BETA PORTFOLIO 63** | **0.679784** | | **BETA PORTFOLIO 68** | **0.528209** |
| | **RETURN** | **0.00562** | | **RETURN** | **-0.00706** |
| | **STD.DEV** | **0.02221** | | **STD.DEV** | **0.036382** |
| **64** | DATALEX | 0.37378 | **69** | IFG GROUP | 0.456412 |
| | KERRY GROUP | 0.260824 | | TULLOW OIL | 0.444841 |
| | GLANBIA | 0.252957 | | KERRY GROUP | 0.431248 |
| | ABBEY | 0.11695 | | GLANBIA | 0.251872 |
| | DIAGEO | 0 | | IRISH CONTINENTAL GROUP | 0.249249 |
| | **BETA PORTFOLIO 64** | **0.200902** | | **BETA PORTFOLIO 69** | **0.366724** |
| | **RETURN** | **0.002965** | | **RETURN** | **0.001669** |
| | **STD.DEV** | **0.013212** | | **STD.DEV** | **0.02918** |
| **65** | TESCO PLC | 0 | **70** | PROVIDENCE RESOURCES | 0.235291 |
| | DONEGAL INVESTMENT GROUP | -0.08702 | | DIAGEO | 0 |
| | PROVIDENCE RESOURCES | -0.25985 | | TESCO PLC | 0 |
| | OVOCA GOLD | -0.27619 | | OVOCA GOLD | -0.02242 |
| | ORMONDE MINING | -0.44593 | | DONEGAL INVESTMENT GROUP | -0.11775 |
| | **BETA PORTFOLIO 65** | **-0.2138** | | **BETA PORTFOLIO 70** | **0.019024** |
| | **RETURN** | **0.002196** | | **RETURN** | **0.002621** |
| | **STD.DEV** | **0.03137** | | **STD.DEV** | **0.025886** |

**Table 9: Semi-annual Portfolios construction 2008.**

**1st SEMESTER 2008**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| **71** | RYANAIR HOLDINGS | 1.44814 |
| | BANK OF IRELAND | 1.260025 |
| | PERMANENT TSB | 1.163359 |
| | INDEPENT NEWS&MEDIA | 1.085328 |
| | ALLIED IRISH BANKS | 1.07309 |
| | **BETA PORTFOLIO 71** | **1.205989** |
| | **RETURN** | **-0.01211** |
| | **STD.DEV** | **0.047407** |
| **72** | OVOCA GOLD | 1.020856 |
| | KINGSPAN GROUP | 0.853856 |
| | CRH | 0.76301 |
| | ABBEY | 0.720736 |
| | KERRY GROUP | 0.640019 |
| | **BETA PORTFOLIO 72** | **0.799695** |
| | **RETURN** | **-0.01179** |
| | **STD.DEV** | **0.036241** |
| **73** | IRISH CONTINENTAL GROUP | 0.43603 |
| | TULLOW OIL | 0.367649 |
| | CPL RESOURCES | 0.292788 |
| | PROVIDENCE RESOURCES | 0.241829 |
| | IFG GROUP | 0.240669 |
| | **BETA PORTFOLIO 73** | **0.315793** |
| | **RETURN** | **0.000876** |
| | **STD.DEV** | **0.031456** |
| **74** | PADDY POWER BETFAIR | 0.114201 |
| | FBD HOLDINGS | 0.060514 |
| | ORMONDE MINING | 0.020123 |
| | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | **BETA PORTFOLIO 74** | **0.038968** |
| | **RETURN** | **-0.00092** |
| | **STD.DEV** | **0.025014** |
| **75** | DONEGAL INVESTMENT GROUP | -0.01658 |
| | DATALEX | -0.02273 |
| | AMINEX | -0.08565 |
| | GLANBIA | -0.10339 |
| | KENMARE RESOURCES | -1.45749 |
| | **BETA PORTFOLIO 75** | **-0.33717** |
| | **RETURN** | **0.023483** |
| | **STD.DEV** | **0.112502** |

**2nd SEMESTER 2008**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| **76** | BANK OF IRELAND | 1.975901 |
| | PERMANENT TSB | 1.812772 |
| | ALLIED IRISH BANKS | 1.585157 |
| | INDEPENT NEWS&MEDIA | 1.380879 |
| | KINGSPAN GROUP | 1.2769 |
| | **BETA PORTFOLIO 76** | **1.606322** |
| | **RETURN** | **-0.03969** |
| | **STD.DEV** | **0.132912** |
| **77** | RYANAIR HOLDINGS | 1.038566 |
| | CRH | 0.961421 |
| | FBD HOLDINGS | 0.817233 |
| | PADDY POWER BETFAIR | 0.742997 |
| | TULLOW OIL | 0.642593 |
| | **BETA PORTFOLIO 77** | **0.840562** |
| | **RETURN** | **-0.01148** |
| | **STD.DEV** | **0.069955** |
| **78** | IFG GROUP | 0.515381 |
| | PROVIDENCE RESOURCES | 0.459233 |
| | GLANBIA | 0.44395 |
| | AMINEX | 0.430563 |
| | OVOCA GOLD | 0.412695 |
| | **BETA PORTFOLIO 78** | **0.452364** |
| | **RETURN** | **-0.03391** |
| | **STD.DEV** | **0.067692** |
| **79** | CPL RESOURCES | 0.365725 |
| | ORMONDE MINING | 0.310603 |
| | DATALEX | 0.259198 |
| | ABBEY | 0.239203 |
| | KERRY GROUP | 0.135877 |
| | **BETA PORTFOLIO 79** | **0.262121** |
| | **RETURN** | **-0.02133** |
| | **STD.DEV** | **0.048796** |
| **80** | DONEGAL INVESTMENT GROUP | 0.106946 |
| | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | IRISH CONTINENTAL GROUP | -0.02127 |
| | KENMARE RESOURCES | -0.69523 |
| | **BETA PORTFOLIO 80** | **-0.12191** |
| | **RETURN** | **0.019** |
| | **STD.DEV** | **0.107952** |

**Table 10: Semi-annual Portfolios construction 2009.**

**1st SEMESTER 2009**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 81 | ALLIED IRISH BANKS | 4.828826 |
| | BANK OF IRELAND | 4.763236 |
| | PERMANENT TSB | 2.629773 |
| | INDEPENT NEWS&MEDIA | 2.350094 |
| | KINGSPAN GROUP | 1.191997 |
| | **BETA PORTFOLIO 81** | **3.152785** |
| | **RETURN** | **0.057661** |
| | **STD.DEV** | **0.254176** |
| 82 | IFG GROUP | 1.043916 |
| | CRH | 0.917752 |
| | AMINEX | 0.896894 |
| | TULLOW OIL | 0.751091 |
| | GLANBIA | 0.722541 |
| | **BETA PORTFOLIO 82** | **0.866439** |
| | **RETURN** | **0.019261** |
| | **STD.DEV** | **0.075643** |
| 83 | RYANAIR HOLDINGS | 0.654789 |
| | PADDY POWER BETFAIR | 0.625165 |
| | FBD HOLDINGS | 0.604527 |
| | KERRY GROUP | 0.480098 |
| | CPL RESOURCES | 0.373429 |
| | **BETA PORTFOLIO 83** | **0.547601** |
| | **RETURN** | **0.008931** |
| | **STD.DEV** | **0.046163** |
| 84 | DATALEX | 0.35846 |
| | PROVIDENCE RESOURCES | 0.346757 |
| | ORMONDE MINING | 0.309893 |
| | IRISH CONTINENTAL GROUP | 0.260652 |
| | DONEGAL INVESTMENT GROUP | 0.227309 |
| | **BETA PORTFOLIO 84** | **0.300614** |
| | **RETURN** | **0.009284** |
| | **STD.DEV** | **0.07403** |
| 85 | ABBEY | 0.183414 |
| | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | KENMARE RESOURCES | -0.33222 |
| | OVOCA GOLD | -0.88938 |
| | **BETA PORTFOLIO 85** | **-0.20764** |
| | **RETURN** | **0.045502** |
| | **STD.DEV** | **0.119263** |

**2nd SEMESTER 2009**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 86 | BANK OF IRELAND | 2.676076 |
| | ALLIED IRISH BANKS | 2.10837 |
| | PERMANENT TSB | 1.214924 |
| | CRH | 0.991932 |
| | KINGSPAN GROUP | 0.988086 |
| | **BETA PORTFOLIO 86** | **1.595878** |
| | **RETURN** | **0.003329** |
| | **STD.DEV** | **0.073382** |
| 87 | RYANAIR HOLDINGS | 0.917249 |
| | DATALEX | 0.901746 |
| | FBD HOLDINGS | 0.588295 |
| | CPL RESOURCES | 0.539989 |
| | PADDY POWER BETFAIR | 0.476398 |
| | **BETA PORTFOLIO 87** | **0.684736** |
| | **RETURN** | **0.004397** |
| | **STD.DEV** | **0.035239** |
| 88 | GLANBIA | 0.409058 |
| | IFG GROUP | 0.400312 |
| | TULLOW OIL | 0.366653 |
| | DONEGAL INVESTMENT GROUP | 0.286439 |
| | ABBEY | 0.239793 |
| | **BETA PORTFOLIO 88** | **0.340451** |
| | **RETURN** | **0.007831** |
| | **STD.DEV** | **0.022991** |
| 89 | KERRY GROUP | 0.120184 |
| | ORMONDE MINING | 0.035397 |
| | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | IRISH CONTINENTAL GROUP | -0.00047 |
| | **BETA PORTFOLIO 89** | **0.031023** |
| | **RETURN** | **0.005795** |
| | **STD.DEV** | **0.022663** |
| 90 | PROVIDENCE RESOURCES | -0.16199 |
| | AMINEX | -0.1691 |
| | OVOCA GOLD | -0.35025 |
| | KENMARE RESOURCES | -1.86331 |
| | INDEPENT NEWS&MEDIA | -22.7298 |
| | **BETA PORTFOLIO 90** | **-5.05489** |
| | **RETURN** | **-0.34882** |
| | **STD.DEV** | **1.247165** |

**Table 11: Semi-annual Portfolios construction 2010.**

**1st SEMESTER 2010**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 91 | PROVIDENCE RESOURCES | 139.3489 |
| | BANK OF IRELAND | 2.803298 |
| | ALLIED IRISH BANKS | 2.710195 |
| | PERMANENT TSB | 1.597498 |
| | TULLOW OIL | 1.249397 |
| | **BETA PORTFOLIO 91** | **29.54186** |
| | **RETURN** | **0.598678** |
| | **STD.DEV** | **0.613254** |
| 92 | DATALEX | 1.131394 |
| | KENMARE RESOURCES | 1.106855 |
| | CRH | 1.023215 |
| | FBD HOLDINGS | 0.966542 |
| | RYANAIR HOLDINGS | 0.875565 |
| | **BETA PORTFOLIO 92** | **1.020714** |
| | **RETURN** | **0.016972** |
| | **STD.DEV** | **0.098972** |
| 93 | ORMONDE MINING | 0.830538 |
| | GLANBIA | 0.671036 |
| | AMINEX | 0.664563 |
| | KINGSPAN GROUP | 0.65429 |
| | KERRY GROUP | 0.569675 |
| | **BETA PORTFOLIO 93** | **0.67802** |
| | **RETURN** | **0.00038** |
| | **STD.DEV** | **0.05931** |
| 94 | PADDY POWER BETFAIR | 0.520727 |
| | IRISH CONTINENTAL GROUP | 0.381939 |
| | IFG GROUP | 0.339019 |
| | CPL RESOURCES | 0.275618 |
| | DIAGEO | 0 |
| | **BETA PORTFOLIO 94** | **0.303461** |
| | **RETURN** | **0.001945** |
| | **STD.DEV** | **0.025812** |
| 95 | TESCO PLC | 0 |
| | DONEGAL INVESTMENT GROUP | -0.22285 |
| | INDEPENT NEWS&MEDIA | -0.38884 |
| | OVOCA GOLD | -7.66497 |
| | ABBEY | -9.91001 |
| | **BETA PORTFOLIO 95** | **-3.63733** |
| | **RETURN** | **0.101613** |
| | **STD.DEV** | **0.420682** |

**2nd SEMESTER 2010**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| 96 | INDEPENT NEWS&MEDIA | 6.109793894 |
| | BANK OF IRELAND | 2.414794986 |
| | CRH | 1.865363543 |
| | PERMANENT TSB | 1.457573353 |
| | ALLIED IRISH BANKS | 1.416900285 |
| | **BETA PORTFOLIO 96** | **2.652885212** |
| | **RETURN** | **0.034081209** |
| | **STD.DEV** | **0.08720793** |
| 97 | KINGSPAN GROUP | 1.372716758 |
| | TULLOW OIL | 0.774204477 |
| | PADDY POWER BETFAIR | 0.753629366 |
| | ABBEY | 0.48716477 |
| | OVOCA GOLD | 0.395680411 |
| | **BETA PORTFOLIO 97** | **0.756679157** |
| | **RETURN** | **0.010233657** |
| | **STD.DEV** | **0.032612482** |
| 98 | RYANAIR HOLDINGS | 0.256531825 |
| | GLANBIA | 0.181894954 |
| | KERRY GROUP | 0.180840851 |
| | FBD HOLDINGS | 0.17825244 |
| | IRISH CONTINENTAL GROUP | 0.168114346 |
| | **BETA PORTFOLIO 98** | **0.193126883** |
| | **RETURN** | **0.002706816** |
| | **STD.DEV** | **0.013706071** |
| 99 | DATALEX | 0.144854945 |
| | PROVIDENCE RESOURCES | 0.123983747 |
| | CPL RESOURCES | 0.106096482 |
| | IFG GROUP | 0.102789491 |
| | DIAGEO | 0 |
| | **BETA PORTFOLIO 99** | **0.095544933** |
| | **RETURN** | **0.01347751** |
| | **STD.DEV** | **0.039809158** |
| 100 | TESCO PLC | 0 |
| | ORMONDE MINING | -0.338345831 |
| | KENMARE RESOURCES | -0.343023295 |
| | DONEGAL INVESTMENT GROUP | -0.416178406 |
| | AMINEX | -0.603935511 |
| | **BETA PORTFOLIO 100** | **-0.340296609** |
| | **RETURN** | **0.022071129** |
| | **STD.DEV** | **0.152520095** |

**Table 12: Semi-annual Portfolios construction 2011.**

**1st SEMESTER 2011**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| **101** | ALLIED IRISH BANKS | 3.675225 |
| | CRH | 1.337391 |
| | BANK OF IRELAND | 1.109574 |
| | RYANAIR HOLDINGS | 1.056214 |
| | ORMONDE MINING | 0.912037 |
| | **BETA PORTFOLIO 101** | **1.618088** |
| | **RETURN** | **-0.00636** |
| | **STD.DEV** | **0.061879** |
| **102** | OVOCA GOLD | 0.72942 |
| | KINGSPAN GROUP | 0.627381 |
| | KERRY GROUP | 0.568378 |
| | GLANBIA | 0.564108 |
| | TULLOW OIL | 0.524847 |
| | **BETA PORTFOLIO 102** | **0.602827** |
| | **RETURN** | **0.001318** |
| | **STD.DEV** | **0.023236** |
| **103** | PADDY POWER BETFAIR | 0.383738 |
| | IRISH CONTINENTAL GROUP | 0.1572 |
| | ABBEY | 0.144497 |
| | FBD HOLDINGS | 0.098393 |
| | DIAGEO | 0 |
| | **BETA PORTFOLIO 103** | **0.156766** |
| | **RETURN** | **0.002584** |
| | **STD.DEV** | **0.009974** |
| **104** | TESCO PLC | 0 |
| | CPL RESOURCES | -0.01561 |
| | AMINEX | -0.08351 |
| | DONEGAL INVESTMENT GROUP | -0.08685 |
| | IFG GROUP | -0.10366 |
| | **BETA PORTFOLIO 104** | **-0.05792** |
| | **RETURN** | **0.002335** |
| | **STD.DEV** | **0.04155** |
| **105** | INDEPENT NEWS&MEDIA | -0.23196 |
| | KENMARE RESOURCES | -0.55697 |
| | DATALEX | -0.7669 |
| | PERMANENT TSB | -0.92717 |
| | PROVIDENCE RESOURCES | -0.9505 |
| | **BETA PORTFOLIO 105** | **-0.6867** |
| | **RETURN** | **-0.00036** |
| | **STD.DEV** | **0.091893** |

**2nd SEMESTER 2011**

| PORTFOLIO | COMPANY | BETA |
|---|---|---|
| **106** | ALLIED IRISH BANKS | 2.500548 |
| | CRH | 1.444605 |
| | BANK OF IRELAND | 1.306114 |
| | TULLOW OIL | 1.11562 |
| | PERMANENT TSB | 1.087306 |
| | **BETA PORTFOLIO 106** | **1.490839** |
| | **RETURN** | **-0.00012** |
| | **STD.DEV** | **0.073453** |
| **107** | ORMONDE MINING | 0.909746 |
| | KINGSPAN GROUP | 0.885115 |
| | KENMARE RESOURCES | 0.869649 |
| | RYANAIR HOLDINGS | 0.850307 |
| | KERRY GROUP | 0.760503 |
| | **BETA PORTFOLIO 107** | **0.855064** |
| | **RETURN** | **0.017019** |
| | **STD.DEV** | **0.180148** |
| **108** | PADDY POWER BETFAIR | 0.742823 |
| | OVOCA GOLD | 0.718595 |
| | AMINEX | 0.703563 |
| | PROVIDENCE RESOURCES | 0.592012 |
| | DONEGAL INVESTMENT GROUP | 0.54088 |
| | **BETA PORTFOLIO 108** | **0.659575** |
| | **RETURN** | **-0.00453** |
| | **STD.DEV** | **0.060034** |
| **109** | GLANBIA | 0.481761 |
| | FBD HOLDINGS | 0.377537 |
| | DATALEX | 0.257342 |
| | IRISH CONTINENTAL GROUP | 0.19317 |
| | IFG GROUP | 0.139385 |
| | **BETA PORTFOLIO 109** | **0.289839** |
| | **RETURN** | **-0.00364** |
| | **STD.DEV** | **0.025987** |
| **110** | INDEPENT NEWS&MEDIA | 0.043449 |
| | DIAGEO | 0 |
| | TESCO PLC | 0 |
| | ABBEY | -0.05459 |
| | CPL RESOURCES | -0.12859 |
| | **BETA PORTFOLIO 110** | **-0.02795** |
| | **RETURN** | **-0.00648** |
| | **STD.DEV** | **0.010212** |