

**An Examination on the use of Technical  
Trading rules versus a Buy-and-Hold Trading  
Strategy in the Irish Stock Market.**

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# **Abstract**

Much literature debates the validity of stock price prediction. Within this research the accuracy of trading rules was examined. In particular this research focused on whether certain basic technical analysis methods for investing in the stock market can yield higher returns, on average, than a simple buy-and-hold strategy. This method of technical analysis selected for investigation was the crossing of moving averages. Such an approach allows for central research objective to be addressed where the central objective was to identify the usefulness of technical analysis, specifically the moving averages trading rule approach and estimate whether it yields higher returns lower losses than a Simple Buy-and-Hold trading strategy. This research will contribute to existing literature by carrying out a quantitative examination of trading rules within the Irish stock market. A sample of fifty-six Irish stocks which were quoted on the ISEQ was selected for analysis. Criteria for the sample were that the stock must have traded for a least five years between the years 2001 and 2011. The returns on the fifty-six stocks were recorded and empirical tested as to the usefulness and power of moving average trading rules in price prediction was undertaken.



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# 1.0 Introduction

## 1.1 Background to Stock Price Prediction

Ever since people have traded stocks on the stock market, there has been speculation on what direction the price of the stock will go. If a person bought a stock and that stock's price increased, the person could sell the stock and make a profit. Profit seeking investors/traders are encouraged to speculate on the future of a stock price in order to make their investment decision. Speculators and investors have to choose, either, buy, to sell or hold the stock?, thus making a profit or loss. Fama (1995) argues that an investment professional should use simple the buy and hold policy, as long run financial markets give a good rate of return despite periods of volatility or decline. This is unless they are willing to take upon themselves greater risk for a greater return. This is in line with the theory of random walk which in simple terms states stock prices move in a random manner, and cannot be predicted by using previous stock prices. Currently there is no real answer to whether stock prices follow a random walk, although there is increasing evidence they do not (Dupernex, 2007).

Some investment professionals and academics, who do not necessarily subscribe to the Random Walk Theory, believe that charts of past prices provide signals of the future, and have and as such used chart prices to predict price movements and assist them in their investment decision making (Damodaran, 2003). A number of stock market behaviour models have been tested and developed over the last decade for this purpose. Two longstanding models that have evolved within the academic literature concerning the debate of whether market prices can be predicted

or follow a random walk are the Efficient Market Hypothesis and the Theory of Random Walk. The EMH states it is impossible to outperform the overall market using expert stock selection. This will be discussed more comprehensively in the literature review.

As recent as thirty-five years ago, the efficient market hypothesis (EMH) was considered a central theory in finance. By the mid-1970s there was such strong theoretical and empirical evidence supporting the EMH propositions. However, recently there has been an emergence of counter arguments against the EMH Theory (Dupernex, 2007).

According to Jensen (1978) the EMH states investors cannot make profits from any relationships between stocks, where such relationships are referred to as correlations within the context of finance. For example in a very simple portfolio, a typical investor would want a weak or negative correlation between the stock returns. The practical implications of this would be the investor holds stocks that are not related or correlated with each other as such loss is minimised when the price movements are considered. In particular Jensen (1978) argues that EMH states investors cannot make profits from correlations between returns after deducting all the costs of trading and adjusting for risk. In other words, any correlation found between returns is too little for the investor to actually make a profit after costs.

Taylor (1982) who claimed that future prices on average will equal the most recently observed price. This has led to a number of academics advocating the application of the Random Walk Hypothesis within the context of financial markets.

and stock price movements. The Random Walk Hypothesis implies that excess returns are not obtainable through the use of information contained in the past movement of prices, thus, a movement in price of a stock cannot be predicted at its simplest form (Taylor 1982). Also the Random Walk Hypothesis indicates that daily stock prices are uncorrelated i.e. (the price of a stock today will have no effect on the price of the same stock tomorrow). Cargill et al. (1975) argues that this is not always the case and perfectly uncorrelated prices can only be attributed to small stock markets and American commodity futures markets.

Experts that try to understand the behaviour of stock prices and standard risk return models e.g. the capital asset pricing model, depend on the hypotheses of Random Walk behaviour of prices. For investment professionals, trading strategies have to be designed to take into account if the prices are characterised by Random Walks or by persistence (the tendency of a stock price to continue moving in its present direction) in the short run, and mean reversion in the long run (stock prices eventually move back towards the mean/ average price) (Borges, 2007).

The Random Walk Hypothesis and the EMH are very important theories as they heavily influence how investment professionals and academics think about stock market fluctuations. Both theories have been relatively based on the independence of stock price fluctuations. Can investment professionals use today's stock price to judge what tomorrow's stock price will be? The literature review will critique the findings for and against this question. Another means to testing independence?, is to test directly different trading rules to see whether or not they provide profits greater than buy and hold trading strategy (Fama, 1995). This is where Technical Analysis comes

into the research. As Fama (1995) states testing Technical Analysis trading rules is a means to find if there is or not independence within the stock price movements, thus giving evidence towards/against the predictability of a stock price.

## 1.2 Objectives of Study

Much literature debates the validity of stock price prediction. Within this research the accuracy of trading rules was examined. In particular this research focused on whether certain basic technical analysis methods for investing in the stock market can yield higher returns, on average, than a simple buy-and-hold strategy. This method of technical analysis selected for investigation was the crossing of moving averages. Such an approach allows for central research objective to be addressed where the central objective was to identify the usefulness of technical analysis, specifically the moving averages trading rule approach and estimate whether it yields higher returns lower losses than a Simple Buy-and-Hold trading strategy.

This research will contribute to existing literature by carrying out a quantitative examination of trading rules within the Irish stock market. A sample of fifty-six Irish stocks which were quoted on the ISEQ was selected for analysis. Criteria for the sample were that the stock must have traded for a least five years between the years 2001 and 2011. The returns on the fifty-six stocks were recorded and empirical tested as to the usefulness and power of moving average trading rules in price prediction was undertaken.

The Literature review chapter will provide a critical review and analysis of literature relevant to the research question as well as similar studies carried out in

various different contexts. The literature review will provide for the reader a background to the study as well as justification for this research. Finally, the literature will provide a rationale for the methodological approach undertaken within the study to address the research question.

### **1.3 Chapter Outline**

As stated at the end of the previous section, the literature review will provide the background to the study. It begins with Technical analysis as it is the core of the examination. This will be followed by the theories that are on the opposite side of the debate about stock price prediction. Within these sections, price prediction tools will be touched upon from the non-believers side of the stock price prediction debate. This will be followed up with an analysis of Technical Analysis which leads into the research aim objectives.

The following chapter will explain the methodology that was used in this study to achieve the research aims and objectives. The study will conclude with the findings and discussion of which such findings.

## 2.0 Literature Review

### 2.0 Introduction to Technical Analysis

While Acar and Satchell (1997) propose that the study of Technical Analysis by academics is relatively new in comparison to the predictability of assets returns there has been much written in both academic and professional literature regarding its validity and use

Fama & Blume (1966), Allen and Karjalainen (1999), and Ratner and Leal (1999) in their investigation on technical analysis, demonstrated empirically that technical analysis does not have validity and the practice does not predict future price movements (especially those around the formulation of the Efficient Market Hypothesis) Kavajecz & Orders, (2004) also investigated the validity of technical analysis In their study looking at technical analysis and efficient market theory they dismissed technical analysis and claimed it was inconsistent with the Efficient Market Theory However, many academics disagree with this perspective

Jensen & Bennington (1970) and Jegadeesh (2000) have put the predictability of Technical trading rules down to data snooping or methodological flaws in empirical analysis Also Fama and Blume (1966), Bessembinder and Chan (1998) and Ready (2002) have also provided evidence in their papers that when there is significant evidence of return patterns, they do not necessarily enough profits to outweigh transaction costs

Neftci & Policano (1984), Brock et al (1992), Neely et al, (1997) however have all found evidence that technical analysis and associated charting methodologies can provide information beyond what is already contained in stock prices, and thus did have validity in stock prediction. Lo and MacKinlay (1988, 1990), and Porteba and Summers (1988) also provided evidence of the validity of technical analysis. In their studies they proposed that patterns in returns data series which could be exploited by technical trading rules (concerning testing the Efficient Market Hypothesis) were evident.

While a comprehensive body of literature in favour of and challenging technical analysis the debate continues. This study will add to the body of literature by examining within an Irish context whether technical analysis had validity in stock prediction. The next section will critically evaluate contemporary literature concerning the central tenants of this research study, that of Efficient Market Hypothesis, Random Walk Theory and Technical Analysis as a tool for price prediction. In order to provide a holistic discussion, a detailed discussion concerning related concepts fundamental analysis and price patterns.

## **2.1 Efficient Market Hypothesis**

The Efficient Market Theory is a long standing academic theory within the domain of finance which examines assets pricing. The Efficient Market Theory sometimes referred to as the Efficient Market Hypothesis (EMH) states that existing

share prices always incorporate and reflect all relevant information and as such it is impossible to outperform the market

According to the EMH, stocks always trade at their fair value on stock exchanges, thus, making it impossible for investors to either purchase undervalued stocks or sell stocks for inflated prices. For an investment professional it is impossible to outperform the overall market through expert stock selection or market timing. Thus, an investment professional must obtain riskier investment to achieve higher returns.

The Efficient Market Theory has been a major issue in financial literature, for the past thirty years. According to Fama (1965, 1970) the EMH which assumes a perfect capital market in which all information is freely available to all participants, there are no transaction costs, and all participants are price takers. According to Mashaushi (2006, pp 17) *“under these assumptions, firms make production-investment decisions, and consumers choose securities”*

Efficient markets are defined by (Fama, 1995, pp 75) as *“a market where there are large numbers of rational, profit-maximisers actively competing, with each trying to predict future market values of individual securities, and where important current information is almost freely available to all participants”*. In other words an actual price of individual security has already the effects of information in its price based both on events that have already occurred and on future events which the market expects to take place in the future. Thus, an efficient market security's price should be a good estimate of its intrinsic value (Fama, 1995). However, the intrinsic value of a

security can never be determined exactly because of uncertainty. Discrepancies between actual prices and intrinsic values have caused disagreement over actual intrinsic values. In an efficient market the actual price of a security should move around randomly about its intrinsic value according to (Fama, 1995)

Fama (1970) also provides three market conditions consistent with efficiency. *“An efficient market requires a large number of competing profit-maximizing participants that analyse and value securities. Second, information regarding securities arrives in the market in a random fashion, and the timing of announcements is, in general, independent of others. The third assumption is that competing investors must trade and try to adjust security prices rapidly to reflect the effect of new information”* (Mashaushi, 2006 pp 20)

### **2.1.1 Levels of Efficiency**

Also academics often define three levels of market efficiency, which are distinguished by the degree of information reflected in security prices (Brealey & Meyers, 2003). The weak form of efficiency is that prices reflect the information reflected contained in the record of past prices. Thus, it is impossible to make consistently superior profits by studying past returns. Researchers have measured the profitability of some trading rules used by those investors who claim to find patterns in stock prices to test this form of efficiency (Brealey & Meyers, 2003). The Random Walk Hypothesis stems from this level of efficiency.

The second form of market efficiency is that of semi-strong form efficiency. Semi-strong form market requires that prices reflect not just past prices but all other

published information. Thus, if markets are efficient in this sense, then prices will adjust immediately to public information e.g. new issue of stock. Researchers have measured how rapidly security prices respond to different items of news, such as dividend announcements etc (Brealey & Meyers, 2003)

Brown & Warner (1980) analysed the market model while Kewon and Pinkerton (1981) investigated semi-strong form efficiency and its validity in the context of company takeovers. Kewon and Pinkerton (1981's) indicated that the adjustment in stock price is immediate on the day the public becomes aware of a takeover. Patell and Wolfson (1984) concur with this perspective. In their research they claimed that prices move extremely fast when new information is available.

The strong form of efficiency is when prices reflect all the information that can be acquired by analysis of the economy and the company. Thus, superior investors cannot consistently beat the market. Researchers have tested this form of the hypothesis by examining the recommendations of professional security analysts and have searched for mutual funds or pension funds that could predictably outperform the market. For the most part academics claim that professionally managed funds fail to recoup the cost of management. For example Malkiel (1995) found evidence that top performing managers in one year do not consistently perform highly in the years to come while Elton et al (1996) provided evidence on the contrary to this. Conclusively many professional managed funds have used the evidence to give up on superior performance and just "buy the index". This greatly diversifies (similar to negative correlation of the stock as discussed earlier) and lowers costs of the portfolio for the investor.

Roll (1994) undertook to investigate and exploit many of the “inefficiencies” of the market by trading significant amounts according to trading rules suggested by the “inefficiencies” (Malkiel, 1995, Elton et al, 1996) Roll (1994) concluded that one could not return more after transaction costs than a simple-buy-and-hold strategy This perspective was supported by Fama (1995)

### **2.1.2 Investors respond slowly to new information?**

Bernard & Thomas (1989) found that investors underreact to earnings announcements and only become fully aware of the significance as further information arrives Also Loughran & Ritter (1995) found evidence of under-performance from new issues in the long-run When these returns were compared to a portfolio that matched in terms of both, size and book-to-market, this difference in performance disappeared However both, size and book-to-market analysis is acknowledged, they are beyond the scope of this study

Others researchers such as Kahneman & Tversky (1979) and Odean (1998) provide evidence for explaining other behavioural finance related anomalies of the efficient market hypothesis The Behavioural Finance theory doesn't help to explain the long-term question, the under-reaction of investors to earnings announcements Also the evidence on the performance of professionally managed portfolios suggests that many of these anomalies were not so easy to predict Fama (1998) gave evidence of being better off with the efficient-market theory which tells us that overreactions and under-reactions are equally likely because we have not found a theory on when investors will over and under-react

Researches have giving evidence to show other anomalies Markets do not always react to new information instantaneously (Chan et al, 1996) Stock markets can overreact as a result of excessive investor optimism or pessimism (Dissanaike, 1997) and that returns on the market are related to the days of the week (Cross, 1983) or the month of the year (DeBondt and Thaler, 1987)

Adherents to the Efficient Market Hypothesis theory tend to dismiss such anomalies on the grounds of the methodological foundation of the study Alternatively it is argued that even if the anomalies exist, once trading costs are taken into account, it cannot be exploited profitably (Brabazon, 2000) It is widely accepted technically it is difficult to test the EMH The hypothesis can only be tested jointly with a model of expected returns such as the Capital Assets Pricing Model ((The investment should not be undertaken if the expected return does not meet the required return (risk-free security plus a risk premium)) In simple terms, the only risk for which investors are compensated is market risk Thus, specific share risks can be diversified away by holding a portfolio of shares Ross (1976) suggested an alternative model, the Arbitrage Pricing Model *“This model suggests that the price of a share is a linear function of its sensitivity to unanticipated changes in economic variables such as inflation and interest rates”* (Brabazon, 2000, pp 4) This could be evidence towards stock prices being predictable due to economic variables However Economic analysis is beyond the scope of this research

While the Efficient Market Hypothesis is not universally accepted, there is evidence that it is difficult for an investor to outperform the market for a period of

time. Combining this with the irrational behaviour of investors would suggest that prediction of market prices is likely to prove challenging. Stevenson (2000) provided evidence using the ISEQ index that the Irish market is not weak form efficient. He did argue that persistence of returns over time and of seasonal anomalies were present and as such as exist to construct a predictive model in the Irish stock market.

### **2.1.3 Conclusion**

The reason the EMH is related to Random Walk Hypothesis is, in an efficient market, on the average, competition will cause the full effects of new information on intrinsic values to be reflected "*instantaneously*" in actual prices (Fama, 1995, pp 75). However the two implications of this are, actual prices will initially over adjust to changes in intrinsic values as often as they will under adjust. Fama (1995's) second implication is the lag of this adjustment could become an independent random variable with an adjustment of price actually happening before the occurrence of the event which is the basis of the change of intrinsic value. The adjustment property of Efficient Market Hypothesis means, that successive price changes in individual securities will be independent. Thus, this independence points towards a Random Walk Market.

## 2.2 Random Walk Hypothesis

The more efficient the market is, the more random the sequences of price changes are (Brealey and Meyers 2003). However, it should be noted that the Efficient Market Hypothesis and Random Walks do not amount to the same thing. A random walk of stock prices does not imply that the stock market is efficient with rational investors. Brealey and Meyers (2003) define a Random Walk by the fact that price changes are independent of each other. However, similar to the Efficient Market Hypothesis, the Random Walk theorists believe it's impossible to outperform the market without assuming additional risk.

According to Random Walk theorists, stock prices are independent of each other, so the past movement of a stock price or market cannot be used to predict its future movement. Random Walk Theory is a long-standing financial theory utilised in price prediction.

Kendall (1953) in his paper on the behaviour of stock and commodity prices uncovered irregular price cycles. The series he found appeared to be “*a wandering one*” (Kendall, 1953 pp 21). Based on this he confirmed the prices of stocks and commodities seemed to follow a Random Walk (Fama 1995, pp76). The theory of Random Walk as defined by Fama (1995, pp76) states that, “*the past history of the series cannot be used to predict the future in any meaningful way*”. The future path of the price level of a security is no more predictable than the path of a series of cumulated random numbers.

According to Fama (1995) Random Walk Theory is based on a series of steps in which the direction and length of each step is uninfluenced by the previous steps.

The random walk hypothesis states that, because stock prices move randomly, in the long run an investor will do better choosing stocks at random (taking a random walk through the market) than by any other method (Vogt, 2006) Damodaran (2003) in his book simplifies the Random Walk theory and several stock price predictive models for a management perspective According to Damodaran (2003) the stock price reflects all the information in past price Thus, knowing what happened yesterday is of no relation to what will happen today

According to Damodaran (2003, pp183) the first assumption of the Random Walk Theory is that *“investors are rational and form unbiased expectations of the future, based upon all of the information that is available to them at the time”* However, if investors are too optimistic or pessimistic the information will no longer have an equal chance of being good or bad news and therefore *“random walk won’t hold”* (Damodaran, 2003, pp183) If the market price at any point in time is an unbiased estimate of value, the next information that is released concerning the asset, should be just as likely to contain good news as bad Thus, the next price change is just as likely to be positive as it likely to be negative Thus *“each price change will be independent of the previous one, and that knowing an assets price history will not help better predictions of future price changes”* (Damodaran, 2003, pp183)

Malkiel (1973) argues that asset prices typically exhibit signs of random walk and that one cannot consistently outperform market averages According to Damodaran (2003, pp 184) *“when a price is following a random walk, it presumes that investors at any point in time estimate the value of an asset based upon expectations of the future The expectations are both unbiased and rational, using the*

*information that investors have at that point in time. The price of the asset changes only with the release of new information.”* Thus, the Random Walk is associated with the weak-form of Market Efficiency

The second assumption is that price changes are caused by new information. However, trading volume alone can change prices even if there is no new information, according to Damodaran (2003). The independence assumption of the random walk model is only valid as long as knowledge of the past behaviour of the series of price changes cannot be used to increase expected gains. Also, as long as the actual degree of dependence in series of price changes is not expected to make profits of any chartist/technical technique greater than the expected profits under a simple buy-and-hold policy (long run financial markets give a good rate of return despite periods of volatility or decline, so for an investment professional, it is better for them to simply buy and hold the stock (Fama, 1995)).

The random walk hypothesis implies that excess returns are not obtainable through the use of information contained in the past movement of prices. Investment professionals that try to understand the behaviour of stock prices and standard risk return models, e.g. the capital asset pricing model, depend on the hypotheses of random walk behaviour of prices. For investors, trading strategies have to be designed to take into account if the prices are characterised by random walks or by persistence in the short run, and mean reversion in the long run (Borges, 2007).

Over the last years, empirical research on the Random Walk model has focused on testing the hypothesis that successive price changes are independent. According to

Fama (1995) statistical tools such as serial correlation coefficients and analyses of runs of consecutive price changes of the same sign are the most appropriate methodological tools to test this hypothesis. If the assumption of independence is proved, one can infer that there are probably no trading rules and/or chartist techniques are, based solely on patterns in the past history of price changes. Theoretically this would make the profits of the investor greater than they would be with a simple buy and hold policy (long run financial markets give a good rate of return despite periods of volatility or decline so for an investment professional, thus, it is better for them to simply buy and hold the stock). Another means to testing independence proceeds is to test directly different trading rules to see whether or not they provide profits greater than buy and hold (Fama, 1995).

According to Fama (1995) there has been no evidence of important dependence in series of successive price changes using standard statistical tools. Cootner (1962), Fama (1965), Kendall (1953) and Moore (1962) all researched this dependence and found that the sample serial correlation coefficients (actual measurement of correlation) concluded that successive price changes were extremely close to zero, thus this shows evidence against dependence in the changes. However Fama (1970), Fama and French (1988), and Lo and MacKinlay (1988) have giving evidence towards stock price returns not following a random walk and are not normally distributed.

When Fama (1965) analysed runs of successive price changes of the same sign, Granger and Morgenstern, (1963) and Godfrey et al, (1964) analysed spectral analysis techniques. The results supported the independence assumption of the

random walk model. However a chartist or technician would not consider either serial correlations (found in repeating patterns that technical analysts use to determine how well the past price of a security predicts the future price) or runs analyses as adequate tests of whether the past history of series of price changes can be used to increase the investor's profits. According to Fama (1995, pp 77) the reason for this are "*that runs tests are much too rigid in their manner of determining the duration of upward and downward movements in prices*". Chartists have indicated a preference for a more sophisticated method which does not always predict the termination of a movement simply because the price level has changed direction Fama (1995)

The filter technique was applied by Alexander (1961). The profitability of the filter technique can be used to make inferences concerning the potential profitability of other mechanical trading rules (Fama, 1995). Also later Alexander (1961) ignored the higher broker's commissions (transaction costs) incurred under the filter. Still the filter technique could not consistently beat the simple policy of buying and holding the indices.

The nature of uncertainty, for any given time period an analyst has about a 50 per cent chance of doing better than random selection even if his powers of analysis are completely non-existent (basic probability). Basically this means the analyst should do consistently better than random selection, and also must beat random selection by an amount which is at least the cost of the resources which are expended in the process of carrying out his more complicated selection procedures (Fama, 1995). Fisher & Lorie (1964) created a useful benchmark for randomly selected portfolios, they computed rates of return for investments in common stocks

on the New York Stock exchange for various time periods from 1926 to 1960. The basic assumption in all of their computations was that at the beginning of each period studied the investor puts an equal amount of money in each common stock listed at that time on the Exchange. Portfolios should be selected in such a way that they have about the same degree of risk as those managed by the analyst. For evidence against the Random walk hypothesis analysts cannot say they think the securities they select do better than randomly selected securities, they must demonstrate this (Fama, 1995)

The validity of the random walk hypothesis has important implications for financial theories and investment strategies. This leads to issues for academicians and investors. Investment professionals (those who doubt the Efficient Market Hypothesis) consider three broad classes of information in assessing the prospects for a share:

- Fundamental indicators
- Inter-market/Economic indicators
- Technical Analysis

The next section will provide a critical appraisal of these three information classes: Fundamental indicators, Inter-market/Economic indicators, Technical indicators.

## **2.3 Fundamental Analysis**

According to Fama (1995) a fundamental analyst assumes that at any point in time an individual security has an intrinsic value which depends on the earning potential of the security. Thus, the earning potential depends on the quality of

management, outlook for the industry and the economy of the security. However, there is a paradox within the fundamental assumptions. When a fundamental analyst determines whether the actual price of a security is above or below its intrinsic value and attempts to determine if the intrinsic value is getting closer or not, it is basically the same as speculating on the future price of a stock (Fama, 1995). So this leads back to the question, can an investor use historic price patterns to help speculate on the future price of a stock?

## **2.4 Inter-market/Economic indicators**

Inter-market/Economic Indicators and Fundamental Indicators are also used by investment professionals to try and to predict future performance of stock prices, and it is important they are acknowledged, however, they are beyond the scope of this research.

## 2.5 Technical Analysis

Having discussed some of the empirical tests at the beginning of the literature review because this is the main scope of this dissertation, the next section will give the background to Technical Analysis

Technical Analysis is the techniques that investment professionals use to aid their prediction of stock price movement to gain a profit from the buying/selling of the stocks in question

The schools of theory on “price prediction” of stock prices are the “chartist” or “technical” (Fama et al, 1995, pp 76) The basic assumption of all the chartist or technical theories is that history tends to repeat itself Past patterns of price behaviour in individual securities will tend to recur in the future (Fama et al, 1995) Thus to predict price of stock, develop a familiarity with past patterns of price behaviour in order to assess the probability of this pattern repeating itself in the future Thus, the chartist can then “bet” (buy/sell the stock) (Fama et al, 1995, pp 76) and potentially make a profit The chartist techniques attempt to use knowledge of the past behaviour of a price series to predict the probable future behaviour of the series (Fama et al, 1995) The various chartist theories assume that price changes prior to any given day are important in predicting the price change for that day However, rarely an investor is a pure technical analyst, thus this leads to a conjunction of both technical analysis and fundamental analysis This shows the acknowledgment of fundamental analysis is important, however it is beyond the scope of this research

Technical analysis is based on a belief that shares / markets follow certain repeating patterns, perhaps due to underlying behavioural influences (Brabazon,

2000) If this is true, the analysis of past prices may uncover features which precede a price change, thus there is potential to predict future values. Technical analysts argue that the market is not completely semi-strong efficient. By using their analytical skills they can receive returns in the form of excess risk adjusted returns. “*Chartists do not claim to study the causes of market movements rather they examine their affects*” (Brabazon, 2000, pp 11)

Having discussed some of the empirical tests at the beginning of the literature review, the next section will discuss price patterns as these form the basis what Technical Analysis attempts to examine.

### **2.5.1 Price Patterns**

Having discussed some of the empirical tests at the beginning of the literature review, the next section will discuss price patterns as these form the basis what Technical Analysis attempts to examine. Technical analysts examine market movements in aid to identify patterns in price movements, then using these patterns to predict which direction the price will move in the future. These patterns are split into short-term and long-term patterns.

The traditional statistical tool used to examine data for repeating patterns is time series analysis. These analyses collect data on a system over time in order to analyse a system or to predict future trends. “*The assumption is that there is an underlying mathematical structure in the data*” (Brabazon, 2000, pp 9)

The basis for charting is that there are patterns in price movements over short periods of time. Even in a market that follows a perfect random walk, you will see price patterns on some stocks that seem to go against probability. The entire market may go up one day, then down, and then up again, for no other reason than pure chance. So to test if there are significant price patterns, researchers have used serial correlation and run-tests (Damodaran, 2003)

### **2.5.1.1 Serial Correlation**

Statistically serial correlation measures the relationship between price changes in consecutive time periods, thus how much the price change in any period depends upon the price change over the previous time period (Damodaran, 2003). A serial correlation of zero would mean that price changes in consecutive time periods are uncorrelated with each other, thus, they can be viewed as a rejection of the hypothesis that investors can learn about future price changes from past ones (Damodaran, 2003). *“If it is positive, then it could be viewed as evidence of price momentum in markets, and could suggest that returns in a period are more likely to be positive or negative if the prior period's returns were the same (positive or negative). When the correlation is negative, it could be evidence of price reversals, and would be consistent with a market where positive returns are more likely to follow negative returns and vice versa”* (Damodaran, 2003, pp460)

In the viewpoint of an investment strategist a positive serial correlation could be exploited by a strategy of buying after periods with positive returns and selling after periods with negative returns. A negative serial correlation would suggest a strategy of buying after periods with negative returns and selling after periods with

positive returns (Damodaran, 2003) For example, a stock price rises on day 1 There are three different points of view of serial correlation The first is that the momentum from the day 1 trading will carry into day 2 trading, and that day 2 is more likely to be an up day than a down day The second is that there will be a big profit taking as investor's cash their profits and that the resulting change will make it more likely that tomorrow will be a down day Finally the third is that each day, it's a clean slate, and that what happened today has no implications for what will happen tomorrow (Damodaran, 2003) Since these strategies generate transactions costs, the correlations have to be large enough to allow investors to generate profits to cover these costs Thus it's possible that there could be serial correlation in returns, without any opportunity for investors to earn excess returns (Fama, 1995)

Alexander (1964), Cootner (1962) and Fama (1965) earliest studies of serial correlation all looked at large U S stocks and all concluded that the serial correlation in stock prices was small Fama (1965) found that 8 of the 30 stocks listed in the Dow had negative serial correlations and that most of the serial correlations were less than 0.05 (evidence against the past price of a security predicting the future price) Other studies confirm these findings of very low correlation, positive or negative Jennergren & Korsvold (1974) report low serial correlations for the Swedish equity market and Cootner (1961) concluded that serial correlations are low in commodity markets as well as small stocks in the US (Fama, 1965) It is unlikely that there is enough correlation in short-period returns to generate "*excess returns, after you adjust for transactions costs even though there may be statistical significance with some of the correlations*" (Damodaran, 2003, pp 470)

On the other hand, serial correlation in short period returns is affected by market liquidity and the presence of a bid-ask spread (Damodaran, 2003) Not all stocks in an index are liquid, and, in some cases, stocks may not trade during a period When the stock trades in a subsequent period, the resulting price changes can create positive serial correlation, thus, you should expect to see positive serial correlation in daily or hourly returns in illiquid stock market prices (Damodaran, 2003) While the bid-ask spread creates a bias in the opposite direction, if transactions prices are used to compute returns, since prices have an equal chance of ending up at the bid or the ask price The affect that this causes in prices will result in negative serial correlations in returns (Roll, 1984) For the very short return intervals, this bias in serial correlations might create the wrong view that price changes in consecutive time periods are negatively correlated

There are some relatively recent studies that find evidence of serial correlation in returns over short time periods However with high volume stocks, stock prices are more likely to have negative serial correlation while with low volume stocks, stock prices are more likely to continue to move in the same direction i e have positive serial correlation (Conrad et al, 1994) Again, these studies don't suggest that an investment professional can make money out of these correlations

### **2.5.1.2 Runs Tests**

Again Technical Analysis uses runs tests to see if there are price patterns A runs test is based upon a count of the number of runs i e sequences of price increases or decreases, in price changes over time (Damodaran, 2003) It is completely compatible with a random walk, in which can examine a stock's history to see if these

runs happen more frequently or less frequently than they should (50% chance of either) (Damodaran, 2003) There were 18 runs in this price series of 33 periods The actual number of runs in the price series is compared against the number that can be expected in a series of this length using statistical tables If the actual number of runs is lower there is evidence of positive correlation price changes, thus, *“if it is greater than the expected number, there is evidence of negative correlation in”* (Damodaran 2003, pp 471) Damodaran (2003) conducted a study of price changes in the Dow 30 stocks, assuming daily, four day, nine day and sixteen day return intervals and it provided the following results,

Differencing Interval,

	Daily	Four-day	Nine-day	Sixteen-day
Actual runs	735.1	175.7	74.6	41.6
Expected runs	759.8	175.8	75.3	41.7

The actual number of runs in four-day returns (175.8) is almost exactly what one would expect in a random process There is small evidence of positive correlation in daily returns but there is no evidence of deviations from normality for longer return intervals This suggests that there is insufficient evidence that markets are not random, and since such behaviour is consistent with price changes following a random walk However the recurrence of these strings could be viewed as evidence against randomness in price behaviour

### **2.5.1.3 Price Reversals**

The expected-return factor model detects three distinct patterns in the history of stock returns that are predictive of the future including Short-Term reversals, Intermediate-Term Inertia and Long-Term Reversals

#### **2 5 1 3 1 Short-Term Reversals**

Short-term reversals in stock returns were discovered by Jegadeesh (1990) He found that last month's return was predictive of next month's relative return even after removing the trading day that supposedly showed a down-then-up pattern in the returns, even when there is no pattern actually there Jegadeesh (1990) suggests price pressure the reason behind strong performance being closely followed by weak performance and vice versa

Price pressures results seem to make sense, however it is strange that the reversals last as long as they do An explanation for this could be behaviour The market could overreact to more than records of recent success and failure of the part of the firms If a market over-weighted the initial information were positive, the price rises to reflect an overly optimistic prediction of events to follow Thus, there is a greater-than-equal chance of a future negative surprise Thus, an explanation for the very strong one-to-three-month reversal patterns in stock returns

### **2 5 1 3 2 Intermediate-Term Inertia and Long-Term Reversals**

There seems to be a tendency towards positive serial correlation when long term is defined as months. Price momentum involves stock prices over time periods of up to eight months. Stocks that have gone up in the last six months tend to continue to go up whereas stocks that have gone down in the last six months tend to continue to go down (Jegadeesh & Titman, 2001). The momentum effect is just as strong in the European markets (Rouwenhorst, 1998), though it seems to be weaker in emerging markets (Bekaert et al, 1997). A potential explanation of this momentum is that mutual funds are more likely to buy winners and dump past losers, thus, generating price continuity (Grinblatt et al, 1995).

However, long term, when is defined in terms of years, there is negative correlation in returns, suggesting that markets reverse themselves over very long periods. Fama & French (1988) found that serial correlation is more negative in five year returns than in one-year returns, and is much more negative for smaller stocks rather than larger stocks when they examined five year returns on stocks from 1941 to 1985.

### **2 5 1 3 3 Other Reasons for Price Reversals**

Jegadeesh & Titman (1993, pp 15) give evidence for patterns to be related to “*surprises in the magnitudes of reported earnings*” They focused on the 10% of stocks that did the best on the New York exchanges for the period through 1989. The 10% that did the worst were focused on also. The price reactions were observed in the following 36 months. Reactions to the reports continued to be relatively positive for

the winners for the next six months. The winners experienced positive earnings surprises and the losers negative. The reason for this is the earnings numbers generated by the accounting profession (Haugen, 2002). A good earnings report appears to signal for one or two more to come with converse for a bad report. The inefficient market doesn't seem to be aware of this (Bernard & Thomas, 1990). The winners reported good winnings and vice versa. The efficient market is not surprised while the inefficient market is surprised by the continuation. Thus, the source of the intermediate-term inertia in stock returns

The stock market overreacts in between these reports as well as during the days surrounding the reports. The market projects this to continue for many years to come. Basically it projects a long short run, which is too long. In the beyond nine month period the market becomes surprised by the reports of the winners. Jegadeesh & Titman (1993) found 71% confidence on that the losers, on average out-perform. It had priced them based on projection that the earnings would continue to grow at rapid rates for an extended period. Stock prices will then fall with the receipt of each disappointing earnings report. The opposite is happening with the losers, the unexpected stock price rises with each unexpectedly good report. Thus, this shows evidence of a long-term reversal pattern. In summary, good returns over the last three to five years are ominous. Good returns over the last twelve months are a positive sign and good returns over the last one to six are ominous (Jegadeesh & Titman, 1993).

## 2.5.2 Technical Trading Rules

Several empirical studies have tried to establish the efficiency of technical analysis by answering these two questions, does the random walk model capture the reality of stock market price fluctuations? Can technical trading rules or charting techniques consistently generate on average, better than chance predictions of stock prices?

Earlier studies by Alexander (1961), Fama & Blume (1966), Levy (1967), Jensen (1967), and Jensen & Bennington, (1970) claim that technical analysis is invalid. However in recent times studies by Sweeney (1988) and Brock et al (1992) suggest that these opinions on technical analysis might have been not entirely accurate. Sweeney (1988) extends the Fama & Blume (1966) study and concludes that the filter rules used by Fama and Blume (1966) could be used to generate a profit. However this profit is sensitive to transactions costs and the bid-ask spread. Brock et al (1992) used data from the Dow Jones Industrial Average from the first day of trading in 1897 to the last day of trading in 1986, a collection of 90 years of daily data. They tested two of the simplest and most commonly used technical trading rules and conclude that these trading rules did provide strong support for technical strategies, especially for buy signals. While Lo, Wang & Mamaysky (2000) present a fairly convincing defence of technical analysis from the perspective of financial economists. They used daily returns of stocks on the New York Stock Exchange and NASDAQ from 1962 and 1996 and use the most sophisticated computational techniques (rather than human visualisation) to look for pricing patterns. They found that the most common patterns in stocks are double tops and bottoms, however they

also point out that these patterns offer only marginal incremental returns and might not even offer returns after transaction costs. Also Bessembinder & Chan (1995) examined the validity of technical trading rules in Hong Kong, Korea, Japan, and three other Asian countries. They found that technical trading rules show strong forecast ability for the markets of Malaysia, Taiwan, and Thailand. Lai et al (2003) also confirmed this by examining daily stock prices for the Kuala Lumpur Stock Exchange and found technical tools generated positive returns, even after considering transaction costs. Lo, Wang & Mamaysky (2000) present a fairly heavy defence of technical analysis from the perspective of financial economists. They used daily returns of stocks on the New York Stock Exchange and NASDAQ from 1962 and 1996 and use the most sophisticated computational techniques (rather than human visualisation) to look for pricing patterns. They found that the most common patterns in stocks are double tops and bottoms, however they also point out that these patterns offer only marginal incremental returns and might not even offer returns after transaction costs.

Technical Analysis tries to derive profitable buy and sell signals by isolating upward and downward price trends from oscillations around a stable level (Schulmeister, 2005). Thus, technical analysts/ investment professionals try to find an indicator to buy/sell a stock using the following trading rule indicators,

### **2.5.2.1 Support and Resistance**

Support is a price level that a share has reached but not fallen below. Resistance is a price level that the market has reached but has not risen above. A

breach of either of these levels is sometimes considered to indicate a significant change in a share's price, with the level breached then forming a new support or resistance level respectively. From an analyst's point of view, "*support levels represent the minimum price that a large number of current holders of the stock are willing to accept and vice versa for the resistance*" (Brabazon, 2000, pp 11)

### 2 5 2 2 Retracing

Retracing is that prices trends will eventually tend to reverse to visit a support or resistance level. Thus, attempting to predict a future price

### 2 4 2 3 Stochastic Oscillators

$$\frac{C - L}{H - L} * 100$$

$$H - L$$

Where,

- C is the current price
- L is the lowest price in the last x days
- H is the highest price in the last x days

A value nearer 0 is considered to indicate a market which is oversold (which will tend to rise) and a value near 100 indicates a market which is overbought

### Relative Strength Indicator

$$100 - \frac{100}{1 + RS}$$

$$1 + RS$$

- RS =  $\frac{\text{average of up closes for a share over last N days}}{\text{average of down closes over the last N days}}$

Filter rules must put in place in order to interpret the values of these indicators

#### **2 5 2 4 Moving Average Indicators**

*“The simplest systems compare the current share price with a moving average of the share price over some time period”* (Brabazon, 2000, pp 12) At simple terms a buy signal is generated when a share’s price exceeds the moving average and a sell signal when the moving average exceeds the share price (Brabazon, 2000) A variation of this is to use a moving average convergence divergence (MACD) oscillator This is calculated by taking the difference of a short run and a long run moving averages of differing length If the result is positive, this is taken as a signal that the market is trending upward (Brabazon, 2000) Thus, the stock price will continue to increase, resulting in a capital gain for the investment professional

#### **2 5 2 5 Momentum**

The momentum of a security is the ratio of a time lagged price to the current price The rationale is that if strongly trended shares will continue to move in that direction (Brabazon, 2000)

#### **2 5 2 6 Bollinger Bands**

A signal is generated if a price breaks out of the defined range Basically an investor would be to buy a share when it exceeds its previous high in the last four weeks and conversely to sell a share if it falls below its previous four week low Another approach would be to plot plus/minus standard deviations above and below a moving average *“Penetration of the bands by the current day’s price indicates a possible price trend reversal”* (Brabazon, 2000, pp 12)

Other Technical indicators of market sentiment are, price of index put / call options and volume of options traded (Brabazon, 2000)

It is worth noting signals generated by the indicators may well be contradictory. The Neural Network Approach (NNs) should be capable of discriminating between the indicators. Thus, "*placing different reliance on each in varying market conditions*" (Brabazon, 2000, pp 13)

## **3.0 The Research Problem**

### **3.0 Introduction**

Ever since researchers were able to access price data on stocks there has been the debate about whether price changes are random or not. Predictably all tests that were made were by those who believed prices follow a random walk and that they found no price patterns. Price pattern usage has increased over the last thirty years. However this is not to say that this increase of usage is evidence of irrational markets and therefore a potential for profits to be made from these price patterns (Damodaran, 2003). Currently there is no real answer to whether stock prices follow a random walk; although there is increasing evidence they do not (Dupernex, 2007). The literature has found little correlation in the short term, and substantial correlation in the long-term. Thus, why do investment professionals use Technical analysis to predict stock prices when a Simple Buy-and Hold trading strategy has strong evidence for it to yield higher returns after transaction costs have being taking into account? This leads to the question can an investor use technical trading rules to gain a profit after transaction costs are taking into account?

### **3.1 The Aim and Objectives of the Research**

This research adopts a positivist view to investigate; if moving averages are a better method/prediction tool for investing in the Irish stock market? Such an approach will allow for evidence for/against technical trading rules or charting techniques to be gathered and examined. Technical analysis tries to derive profitable

buy and sell signals by isolating upward and downward price trends from oscillations around a stable level (Schulmeister, 2005)

Moving average convergence divergence (MACD) was adopted as the Technical Analysis methodology to examine within this research. This method is considerably powerful one as it is easy for any level of investor to incorporate it in their trading criteria. Similar studies by Wilder (2009) and Van Horne & Parker (1967) also advocated this approach. The importance of this study was to find out if moving averages were a better method for investing in the stock market, than a simple buy-and-hold strategy. Ideally, to test if Technical Analysis yields higher returns than a simple buy-and-hold trading strategy, several trading rules should be incorporated. However, this would be beyond the scope of this research. By empirically testing these two prediction tools used for investing to see which gave better returns, it will become more apparent if Technical Analysis works and if investors should use moving averages as an investment strategy.

The main contribution of this paper is to add to international evidence on technical analysis, by testing fifty-six Irish stocks that contribute to the ISEQ index using Moving Averages. To remove survivorship bias, this paper included stocks that had at any one point traded on the ISEQ between 2001 and 2011. This meant that a stock in the sample maybe not currently contributing towards the ISEQ and could actually be performing badly. A significant time period of a minimum of five years for the stock contributed to the ISEQ was also applied when choosing the stocks. The reason being was that these stocks could be tested for the Buy-and Hold trading strategy over a reasonable time period. Survivorship bias can lead to overly

optimistic beliefs because failures are ignored when considering what data is used in research

The importance of this study is to find out if moving averages are a better method/prediction tool for investing in the stock market, than a simple buy-and-hold strategy in an Irish Stock market context. The following one-tailed hypothesis test will be carried out:

1 Null Hypothesis  $H_0$ : Moving Averages consistently yield higher returns (after transaction costs are taken into account), on average, than a simple buy-and-hold trading strategy.

2 Alternative Hypothesis  $H_a$  (one-tailed): Moving Averages consistently yield lower or flat returns (after transaction costs are taken into account), on average, than a simple buy-and-hold trading strategy.

## 4.0 Methodological Approach

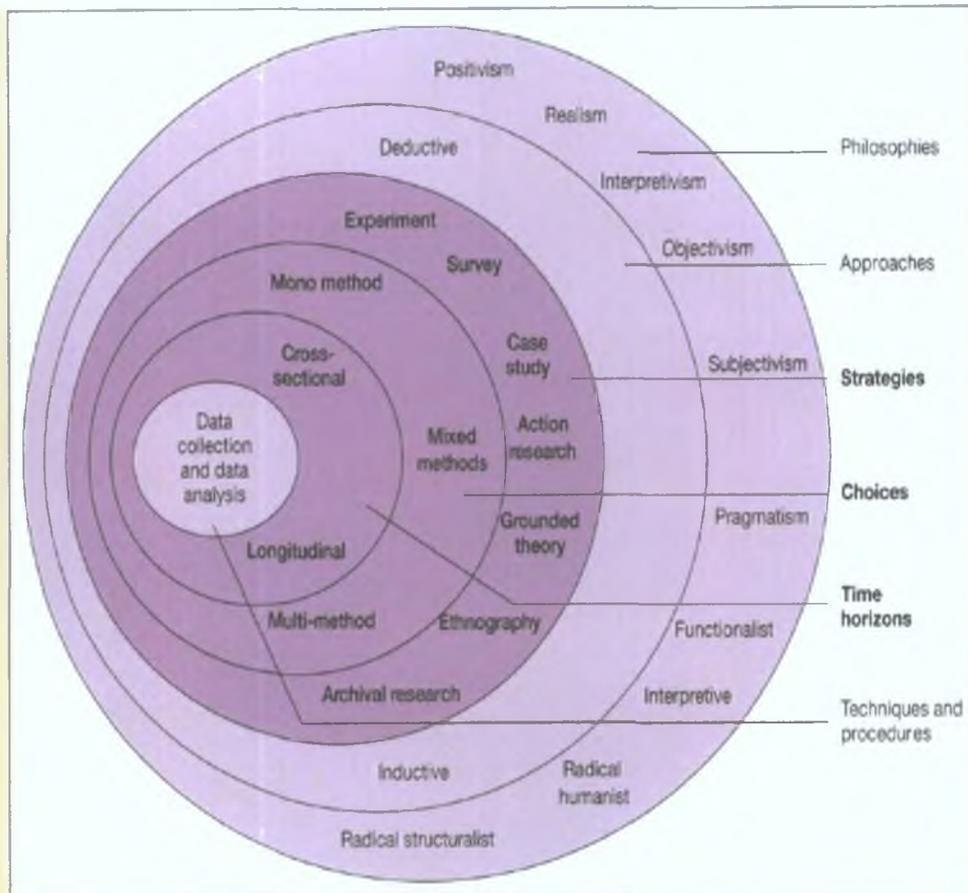


Figure 5.1 The research 'onion'

Source: © Mark Saunders, Philip Lewis and Adrien Thornhill 2006

The Saunders “onion” (2006, pp.128) structure has guided the layout for each stage of the research process undertaken within this research.

### 4.1 Research Philosophy

The research philosophy within this research was one of a positivist. The stance was of a “natural scientist” (Saunders, 2006, pp.134) regarding the angle of epistemology. Epistemology is what constitutes acceptable knowledge in the field of study. From a positivist perspective “*only observable phenomena can provide credible data, facts*” (Saunders, 2006, pp.140). This approach fits this research

because a hypothesis will be tested and confirmed, in whole or part, or refuted, leading to further development of theory which then may be tested by further research. This also fits in with this research as the research must have been undertaken in a value-free way in order to come to scientific conclusion. A positivist perspective methodology is highly structured and this fitted the research because a one-tailed hypothesis needed to be stated and tested to conclude which was a better trading strategy. Existing theory was used to develop the hypothesis tested. From a positivist perspective the data is quantitative, thus this fitted in with this research because stock price movement is measured by a quantitative means.

According to Saunders (2006) axiology is the researcher's view of the role of values in research. From a positivist perspective the research is undertaken in a value-free way and the researcher is independent of data and maintains an objective stance. This fitted this research as stock price returns relatively mean the same everywhere, thus social entities regarding stock prices, exist in reality external to and independent of social actors.

According to Saunders (2006) ontology is the assumptions we make about the way in which the world works or in other words the nature of reality. From a positivist perspective research is external, objective and independent of social actors. This fitted this research as the conclusion was to be unbiased. Again stock price returns are relatively conceived in the same manner everywhere, thus social entities exist in reality external and independent of social actors.

## 4.2 Research Approaches

The approach this research took was a deductive one. The hypothesis in question was the development of a theory was tested scientifically. Again the research used large samples, a highly structured and quantitative methodology. The hypothesis, Moving Averages consistently yield higher returns (after transaction costs are taken into account), on average, than a simple buy-and-hold trading strategy. As the literature has pointed to is that in studies regarding using technical trading tools to help predict the movement of stock prices, after transaction costs have been taken into account there is little difference between the returns on both these strategies. Again highly structured methodology was used, to test the one-tailed hypothesis.

However, there is growing evidence towards the prediction of stock prices is actually possible. So this hypothesis was tested in an Irish market context. Thus, the raw data (quantitative approach) that was used was the closing price of 56 stocks that contribute to the ISEQ index from the period 2/1/2001 to 30/12/2011. According to Saunders (2006) deductive research has the following attributes, operationalised, reductionism and generalisation.

Regarding the research being operationalised, the concept was if the Moving Averages trading tool yielded a greater or worse return than the buy-and-hold strategy (after transaction costs). Also it would constitute that it was greater/worse trading tool than the simple buy-and-hold strategy. Thus the principle of reductionism was being followed. The problem (stock price prediction) as a whole was better when it was reduced to its simplest possible elements. Regarding generalisation, I chose the Irish

stock market to test these two trading strategies. Thus, the results of these tests are only relevant in an Irish context in whether which trading tool yields a higher return. The literature has pointed to other qualitative reasons why stock prices change. However, this was outside the scope for this research.

### **4.3 Methodological Choice**

The methodological choice decided upon by the researcher was to address the research questions solely through the use of quantitative methods. Such a mono-method approach is in line with similar studies as well as the best option for this research (Wilder, 2009, Van Horne & Parker, 1967 and Brabazon, 2000).

This study has used a data analysis procedure using numerical data to test the hypothesis under study using tools as Microsoft Excel to apply 10-day and 20-day moving averages to each stock. A buy or sell sign was created using Excel to find when the short moving average intersected the long moving average. Initially, the study began with a broader focus exploring stock price prediction. However, a broad literature review assisted in funnelling the research question to its current state whereby the objective is to specifically examine the use of technical analysis in stock prediction.

### **4.4 Research Strategy/Strategies**

The research strategies according to Saunders (2011, pp 173) is “*methodological link between the philosophy and subsequent choice of methods to collect and analyse data*”. As this research was conducted in a positivist perspective,

the strategy used was an experiment. Due to the fact that the study was carried out with a natural science stance, the study tested the following hypothesis

1 Null Hypothesis  $H_0$  Moving Averages consistently yield higher returns (after transaction costs are taken into account), on average, than a simple buy-and-hold trading strategy

2 Alternative Hypothesis  $H_a$  (one tailed) Moving Averages consistently yield lower returns (after transaction costs are taken into account), on average, than a simple buy-and-hold trading strategy

The alternative hypothesis is one tailed due to the fact the research is comparing two strategies rather than searching to see if two variables are related. If the latter was the case, the alternative hypothesis would measure and which the direction of the relationship after the null hypothesis was discarded. In this research the alternative hypothesis is one tailed because if the null hypothesis is rejected then there is only one alternative.

The Null hypothesis predicted moving averages will consistently yield higher returns (after transaction costs are taken into account), on average, than a simple buy-and-hold trading strategy. As the reason Moving Averages were introduced as a trading tool was to predict stock price movement, thus allowing the investment professional to yield a higher return than a simple buy-and-hold strategy. However if this is rejected, the alternative hypothesis will test to see if Moving Averages consistently yield lower returns (after transaction costs are taken into account), on

average, than a simple buy-and-hold trading strategy. However, the hypothesis testing will be in an Irish context.

## 4.5 Time Horizon

This research conducted was a “*snapshot*” time horizon or a cross-sectional study (Saunders, 2011, pp190). The reason for this study being a cross-sectional study was the time constraint of the academic course.

## 4.6 Techniques and Procedures

Existing theory has been used to develop the hypothesis. This research tested the technical trading rules “Moving Averages Convergence Divergence”. The research involved quantitative research methods. The literature has pointed to other qualitative reasons why stock prices change. However, this will be outside the scope for this research.

The Moving Average Convergence Divergence trading rule is to buy (go long) when the short-term (faster) moving average crosses the long-term (slower) moving average from below and sell (go short) when the converse occurs. The length of Moving Average short-term usually varies between 1 day and 50 days and the long-term Moving Average is usually between 50 and 200 days. According to Felt (2012) the 10 day and 20 day moving average yielded the highest profitability out of the different moving averages. In his study 3000 stocks were tested using moving averages over a period of about 9 years (or over the period during which the stock

traded if it traded for less than 9 years), factoring in commissions. Similarly this research used Moving Average Convergence Divergence (MACD) oscillator (oscillator tests the strength of the move e.g. the stock could be over-bought or over-sold). This is calculated by taking the difference of a short run and a long run moving averages of differing length. If the result is positive, this is taken as a signal that the market is trending upward. Thus, holding the stock for a period of time until a sell sign appears. This in turn potentially creates a capital gain for the investor. If the stock was to be bought or sold it would be done at the closing price of the day after the moving averages crossed. So the aim of this research was to test the “*most profitable*” moving average according to Felt (2012), the 10 day and 20 day moving average. The closing prices were the only price history data that was available as an adjusted price for splits and dividends. Once all of the historical prices were collected and reduced down to the required timeframe, I calculated all of the required moving averages for each stock using the adjusted closing prices similarly to the study Wilder (2009) and Van Horne & Parker (1967) conducted. €10,000 was used to simulate the purchase of each stock when the first buy signal was indicated by the cross-over of the moving average. €10,000 worth of shares was bought for each stock at that closing price when the crossover happened. Then when the next sell signal was indicated by a cross-over the total number of shares would be sold at that current price, thus making a profit or a loss. This x amount of money would be then used to buy that value of shares worth that amount when the next buy signal was indicated by the moving average cross-over. This would continue for each stock for the same period as the Buy-and-Hold strategy period.

The buy-and-hold strategy simulates the use of €10,000 to buy as many shares as possible for each stock on and hold for the entire five to ten-year study period and sell on the final day (or the length of time the stock traded on the ISEQ) Then I compared the profits/losses to see which method for prediction yielded the higher return after transaction costs have taking into account

To remove survivorship bias, this paper only included stocks that had at any one point traded on the ISEQ between 2001 and 2011 This meant that a stock in the sample maybe not currently contributing towards the ISEQ and actually performing badly The closing price of seventy-two randomly chosen stocks that contributed to the ISEQ from January 1st 2001 to December 31st 2011 was used as data A significant time period of a minimum of five years for the stock contributed to the ISEQ was also applied when choosing the stocks The reason being was that these stocks could be tested for the Buy-and Hold trading strategy over a reasonable time period Hence, the data was cut down to fifty-six stocks to incorporate the Buy-and-Hold strategy Survivorship bias can lead to overly optimistic beliefs because failures are ignored when considering what data is used in research

The research tested the trading tools Moving Average Convergence Divergence (MACD) Oscillator against a Simple Buy-and-Hold strategy to see which yields a greater return after transaction costs have being included If the Moving Average generates a greater return over the general 10-year period than a Simple Buy-and-Hold strategy then this provides evidence that the Moving Average trading rule is a better predictor in the sense of stock market price prediction Thus, this provides evidence that within the Irish Stock Market it is possible to use the Moving Average

trading rule to yield higher returns than simply buying and holding stock. By including transaction costs of €1.50 per transaction (roughly the average flat rate in the Irish stock market) into account, it will answer, is it actually worthwhile using a trading tool? This question arises from the literature stating that there is little to gain after transaction costs have been taken into account. After comparing the total value of money that the investor had at the end of the data period using both methods, it should be clear which method was a better predictor of the Irish Stock market.

## 5.0 Findings

### 5.1 Buy-and-Hold Strategy

With the Buy-and-Hold strategy €10,000 worth of shares were bought at the buy price, resulting in a number of shares being held for period for that stock. At the end of the period these stocks were sold at the sell price on that day, to create a value for the investor. This value was then compared to the starting value to obtain a profit or loss.

Using Allied Irish Bank as an example, 770 shares were bought at the price of €12.98 to a value of €10,000. 2788 closing prices later (roughly 10 years) these 770 shares were sold at the sell price of €0.069 to make a loss of €9,947. This same method was then carried out for the other fifty-five stocks. Twenty-three of these stocks generated a profit, most notably Providence and Dragon Oil which returned a profit €639,684 and €156,152 respectively with an investment of €10,000 each. Thirty-three stocks returned a loss on the €10,000. Overall if €560,000 was invested (€10,000 per stock) at the beginning of the stock contributing to the ISEQ and then sold on the 30/12/2011 for €1,483,683, a profit of €923,683 would have been obtained. The average a stock a made/loss was a profit €16,494.

Name of Stock	Number of Closing Prices when held	Starting Value	Buy Price €	No of Shares	Sell Price	Value €	Profit/Loss	
Abby	2788	0,000	3.82	2617.80	0.17	5.2	3612.6	3.63
Allied Irish bank	2788	0,000	2.98	7704	0.02	0.059	53.587	9.947
Anglo	2042	0,000	3.64	2717	2527.17	0.27	596.54	9.404
Alphrys	560	0,000	3.1	0.98	90.099	2.6	2857.4	7.143
Aerlingus	1335	0,000	2.84	352.1	26761	0.635	2235.92	7.764
Agri	1389	0,000	1.61	621.1	80121	0.055	341.6.5	9.656
Arcon	1082	0,000	0.16	62500	0.17	29375	3.375	-9.375
Aminex	1082	10,000	0.13	23255	81395	0.0409	95.163	9.049
Arnotts	624	0,000	7	128	571429	11.05	2007.1	-0.07
Aryta	652	0,000	33.6	297.6	90476	37.49	11157.7	1.158
Balmora	1347	0,000	0.35	2857.1	42857	0.004	114.286	9.886
Bank of Ireland	2788	10,000	10.69	935	150595	0.082	76.7072	9.923
Barlo	648	10,000	1.04	9615	3846.5	0.46	4423.08	5.577
C and C	1937	0,000	2.29	1366	8122.27	2.89	12532.8	2.533
Cpl	2788	0,000	0.9	1.111	11.11	2.55	28333.3	-8.333
Crn	2788	10,000	19.99	500	2501251	15.56	7683.84	2.3.6
Datalix	2788	10,000	5.7	1754	355965	0.35	6.4.035	9.366
DCC	2788	10,000	11.55	865	8006558	18.28	15826.8	5.827
Donegal	2788	10,000	1.9	5263	157695	3.037	16335.3	6.335
Dragon Oil	2788	0,000	0.33	30303	0303	5.183	166152	156.152
Elan	2788	10,000	54.25	184	3517972	10.72	1976.04	-8.024
FBD	2788	10,000	4.5	2222	222222	6.5	14444.4	4.444
Fyffes	2788	10,000	1.01	9900	990099	0.6303	6240.59	3.759
Glanbia	2788	10,000	0.56	17241	37931	1.625	79741.1	69.741
Greencore	2788	0,000	2.94	3401	360544	0.63	2142.86	7.857
Horizon	1917	10,000	7.1	1408	150704	1.14	1605.63	-8.394
IWP	1329	10,000	1.82	5494	505495	0.035	192.308	9.808
IAWS	1935	10,000	7	1126	571129	17	21265.7	14.266
IFG	2788	10,000	2.3	4347	825087	1.05	4565.22	5.435
Independent	2788	10,000	3.1	3225	806452	0.205	661.29	9.339
IDNA	1952	10,000	67	149	2537313	2.42	361.194	9.639
Irish Con	2788	10,000	6.1	234	567901	15.17	18728.1	8.728
Jurys	1249	10,000	9.83	1017	293998	18.75	19074.3	9.074
Kenmare	2788	10,000	0.29	31482	75862	0.538	18551.7	8.552
Kerry	2788	10,000	13.39	716	8259895	28.825	21527.3	11.527
Kingspan	2788	0,000	4.3	2325	581395	6.36	14790.7	4.791
McInern	2506	10,000	2.45	4061	632653	0.0396	161.633	9.636
Oakhill	1669	10,000	0.36	27777	777.78	0.37	10277.8	278
Ormond	1707	10,000	0.145	68965	51721	0.09	6206.9	3.793
Ovoca	1707	10,000	0.139	71942	44604	0.28	20143.9	10.144
Paddy	2788	10,000	3.1	3225	806452	44.5.5	143597	133.597
Perm TSB	2788	10,000	12.55	796	812749	0.024	19.1235	9.361
Petro	1335	0,000	0.34	29411	76471	0.21	6.76.47	3.824
Providence	1706	0,000	0.038	263157	8947	2.4688	649684	639.684
Qualcream	2.54	0,000	3.02	33.1	258278	0.38	264.90	9.735
Ready mix	2788	10,000	1.47	6802	721088	0.04	272.09	9.728
Ryanair	2788	0,000	1.73	652	5.19.9	3.257	2785.17	7.2.5
Siteserv	1900	10,000	1.08	9259	259259	0.02	185.185	9.8.5
Southwest	1539	0,000	1.45	6896	551721	6.92	47724.	37.724
Thirdforce	2295	10,000	0.78	2820	51282	0.	282.05	-8.718
Total Produce	1269	0,000	0.73	3698	69014	0.37	5058.49	-4.932
TVC	1137	0,000	1.47	6802	721088	0.76	5.70.07	-4.630
Unidare	1335	0,000	2.37	4219	409283	0.4	687.76	-8.312
United Drug	2788	0,000	1.5	869	5652.74	2.05	782.61	-8.217
Viridan	1505	0,000	0.32	968	992248.	19.56	8953.5	8.953
Waterford	2084	0,000	1.25	7936	507937	0.00.	7.9365.	9.992
							Profit/Loss	
		560,000					-483683	923,683

Figure 1 0 (Above)

## 5.2 10-Day and 20-Day Moving Average Convergence

### Divergence Strategy.

ALLIED IRISH BANKS PLC – ESM;

10-day and 20-day Moving Average over 150 days.

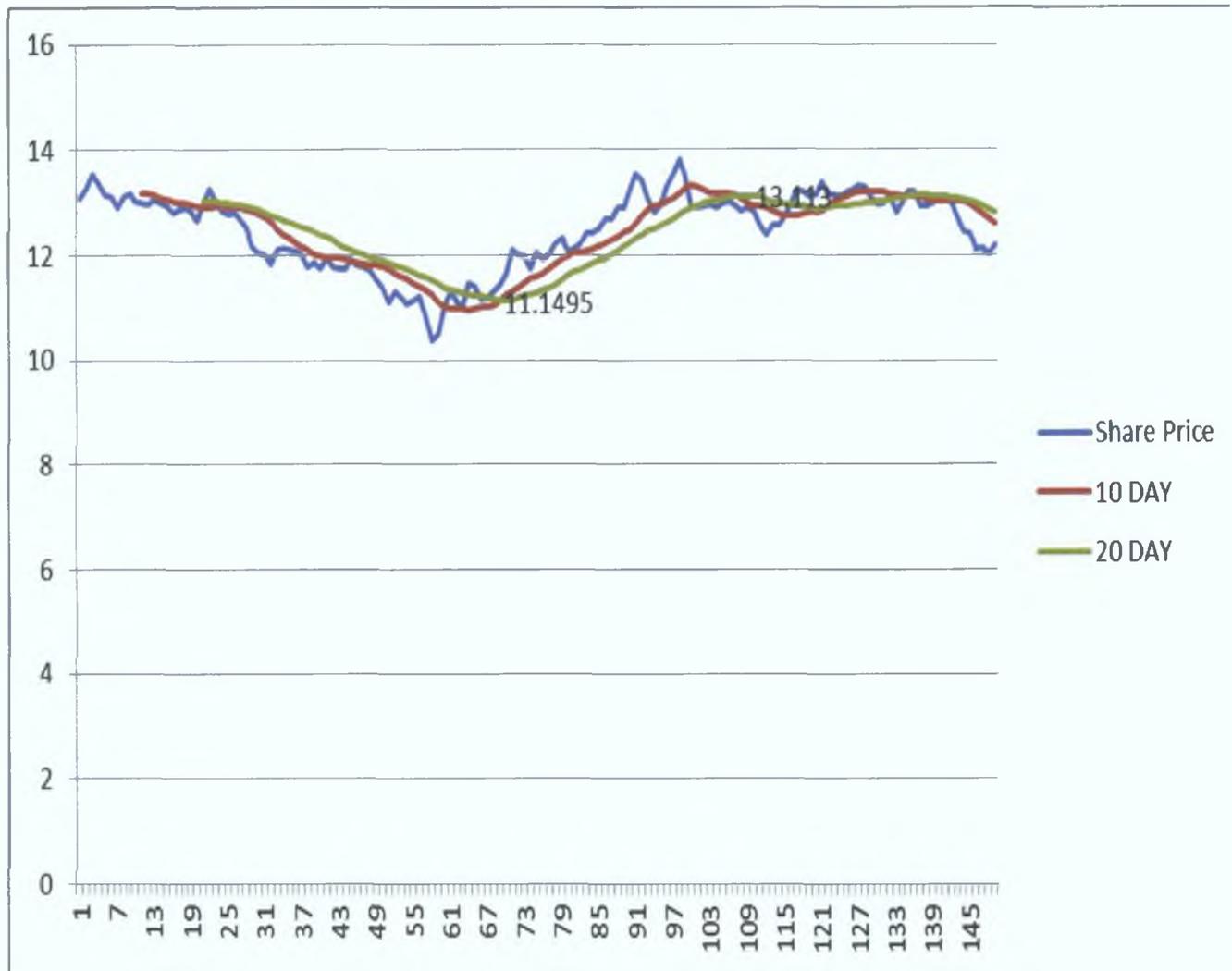


Figure 2.0 (Above)

Figure 2.0 is an example of a Moving Average Convergence Divergence using Allied Irish Bank real data as an example from Figure 1.0. When the 10 day Moving Average moves up through the 20 day Moving Average a buy sign (marked €11.1495) is generated and when the 10 day Moving Average moves down through the 20 day Moving Average a sell sign (marked €13.113) is generated. The logic behind this is

that the price will continue to move in that direction, thus the value of shares continues to increase or decrease

Figure 3 will now show the current balance, profit/loss before transactions costs (assuming €1.50 per transaction) for the fifty-six stocks. It will also show the transactions cost and the profit/loss after transactions costs for the stock in question (stock was bought and sold within the same time period as with the buy and hold). The initial investment in each stock at the beginning was €10,000, however the moving average allowed the investor to buy and sell, thus it allowed the investor to re-invest any profit/loss made from the previous sells. The final balance after selling all the shares was €897,615.40, a combined profit/loss of €354,476.53. The total transactions cost amounted to €10,126. After transaction cost were taken into account the net profit/loss on €560,000 was €344,350.53. Of the fifty-six stocks, twenty-five of them made a profit, hence thirty-one made a loss with this trading strategy.

Name of Stock	Current Balance after Using Moving Averages	Profit	Transaction Costs	Ater Transaction Costs
Abby	9014 261641	985 7383589	478	1463 738359
Allied Irish bank	184 1401133	-9815 859887	238	10053 85989
Anglo	16071 28168	6071 281682	190	5881 281682
Alphrya	9840 799671	159 2003291	32	191 2003291
Aer Lingus	8994 317505	1005 682495	104	1109 682495
Agri	168 4416041	9831 558396	140	9971 558396
Arcon	78096 2486	68096 2486	98	67998 2486
Aminex	383 5373547	9616 462645	128	9744 462645
Arnotts	19973 5402	9973 540199	28	9945 540199
Aryzta	12778 29759	2778 297588	70	2708 297588
Balmora	4777 47456	5222 52544	116	5338 52544
Bank of Ireland	750 1040404	9249 89596	208	9457 89596
Barlo	12530 99293	2530 992925	74	2456 992925
C and C	52792 76837	42792 76837	164	42628 76837
Cpl	49371 11452	39371 11452	204	39167 11452
Crh	3677 944891	6322 055109	240	6562 055109
Datalex	1555 622415	8444 377585	254	8698 377585
DCC	7851 102687	2148 897313	208	2356 897313
Donegal	12100 18352	2100 183518	322	1778 183518
Dragon Oil	48663 6791	38663 6791	232	38431 6791
Elan	61546 13701	51546 13701	228	51318 13701
FBD	41298 4984	31298 4984	244	31054 4984
Fyffes	7778 427153	2221 572847	258	2479 572847
Glanbia	12674 1857	2674 185697	246	2428 185697
Greencore	5300 173183	4699 826817	240	4939 826817
Horizon	21962 54538	11962 54538	158	11804 54538
IWP	4155 153283	5844 846717	116	5960 846717
IAWS	11126 68473	1126 68473	156	970 6847296
IFG	85652 83848	75652 83848	232	75420 83848
Independent	1214 234873	8785 765127	242	9027 765127
IONA	16911 32922	6911 329221	168	6743 329221
Irish Con	45730 45644	35730 45644	244	35486 45644
Jurys	15943 9417	5943 941699	116	5827 941699
Kenmare	18986 03746	8986 037455	206	8780 037455
Kerry	8618 018119	1381 981881	202	1583 981881
Kingspan	16568 50955	6568 509545	210	6358 509545
McInern	16179 27263	6179 27263	180	5999 27263
Oakhill	1430 056822	8569 943178	140	8709 943178
Ormond	6163 762307	-3836 237693	144	-3980 237693
Ovoca	5131 696172	4868 303828	142	5010 303828
Paddy	43637 68737	33637 68737	230	33407 68737
Perm TSB	3021 791035	6978 208965	278	-7256 208965
Petro	2687 310349	7312 689651	130	7442 689651
Providence	10407 58896	407 5889578	140	267 5889578
Qualcream	1016 447	8086 553	160	8246 553
Readymix	1630 675649	8369 324351	240	8609 324351
Ryanair	1675 009423	8324 990577	246	-8570 990577
Siteserv	1581 178462	8418 821538	108	8526 821538
Southwark	39904 0712	29904 0712	120	29784 0712
Thirdforce	247 8436062	9752 156394	208	9960 156394
Total Produce	2073 48	8037 62	106	7931 62
TVC	9071 217478	928 7825218	98	1026 782522
Unidare	8149 154119	1850 845881	134	1984 845881
United Drug	1936 782788	8063 217212	234	8297 217212
Viridan	15427 54779	5427 547786	130	5297 547786
Waterford	1199 800657	-8800 199343	164	8964 199343
Total	897615 3975	354476 5375	10126	344350 5375

**Figure 3 above**

Profit/Loss

Name of Stock	B & H	Moving A	Difference Before T C (+ in Favour of M A)	Transaction Costs	Ater Transaction Costs
Abby	3612 565445	985 7384		4598 303804	478 5076 303804
Allied Irish bank	9946 841294	9815 86		130 9814073	238 107 0185927
Anglo	9403 846154	6071 2817		15475 12784	190 15285 12784
Alphrya	7142 857143	159 2003		6983 656814	32 6951 656814
Aer lingus	7764 084507	1005 682		6758 402012	104 6654 402012
Agri	9658 385093	9831 558		173 1733028	140 313 1733028
Arcon	19375	68096 249		48721 2486	98 48623 2486
Aminex	9048 837209	9616 463		567 625436	128 695 625436
Arnotts	10071 42857	9973 5402		97 88837256	28 125 8883726
Aryzta	1157 738095	2778 2976		1620 559492	70 1550 559492
Balmora	9885 714286	5222 525		4663 188845	116 4547 188845
Bank of ireland	9923 292797	9249 896		673 3968374	208 465 3968374
Barlo	5576 923077	2530 9929		8107 916002	74 8033 916002
C and C	2532 751092	42792 768		40260 01728	164 40096 01728
Cpl	18333 33333	39371 115		21037 78119	204 20833 78119
Crh	2316 158079	6322 055		4005 89703	240 4245 89703
Datalex	9385 964912	8444 378		941 5873275	254 687 5873275
DCC	5826 839827	2148 897		7975 73714	208 8183 73714
Donegal	6335 263158	2100 1835		4235 07964	322 4557 07964
Dragon Oil	156151 5152	38663 679		117487 836	232 117719 836
Elan	8023 963134	51546 137		59570 10015	228 59342 10015
FBD	4444 444444	31298 498		26854 05395	244 26610 05395
Fyffes	3759 405941	2221 573		1537 833093	258 1279 833093
Glanbia	69741 37931	2674 1857		67067 19361	246 67313 19361
Greencore	7857 142857	4699 827		3157 31604	240 2917 31604
Horizon	8394 366197	11962 545		20356 91158	158 20198 91158
IWP	9807 692308	5844 847		3962 84559	116 3846 84559
IAWS	14285 71429	1126 6847		13159 02956	156 13315 02956
IFG	5434 782609	75652 838		81087 62109	232 80855 62109
Independent	9338 709677	8785 765		552 9445499	242 310 9445499
IONA	9638 80597	6911 3292		16550 13519	168 16382 13519
Irish Con	8728 395062	35730 456		27002 06137	244 26758 06137
Jurys	9074 262462	5943 9417		3130 320763	116 3246 320763
Kenmare	8551 724138	8986 0375		434 3133174	206 228 3133174
Kerry	11527 25915	1381 982		12909 24103	202 13111 24103
Kingspan	4790 697674	6568 5095		1777 811871	210 1567 811871
McInern	9838 367347	6179 2726		16017 63998	180 15837 63998
Oakhill	277 7777778	8569 943		8847 720956	140 8987 720956
Ormond	3793 103448	3836 238		43 13424471	144 187 1342447
Ovoca	10143 88489	4868 304		15012 18872	142 15154 18872
Paddy	133596 7742	33637 687		99959 08682	230 100189 0868
Perm TSB	9980 876494	6978 209		3002 667529	278 2724 667529
Petro	3823 529412	7312 69		3489 16024	130 3619 16024
Providence	639684 2105	407 58896		639276 6216	140 639416 6216
Qualcream	9735 099338	8086 553		1648 546338	160 1488 546338
Readymix	9727 891156	8369 324		1358 566805	240 1118 566805
Ryanair	7214 83376	8324 991		1110 156818	246 1356 156818
Siteserv	9814 814815	8418 822		1395 993277	108 1287 993277
Southwarf	37724 13793	29904 071		7820 066735	120 7940 066735
Thirdforce	8717 948718	9752 156		1034 207676	208 1242 207676
Total Produce	4931 506849	8037 62		12969 12685	106 12863 12685
TVC	4829 931973	928 7825		3901 149451	98 3803 149451
Unidare	8312 236287	1850 846		6461 390406	134 6327 390406
United Drug	8217 391304	8063 217		154 1740919	234 79 82590811
Viridan	8953 488372	5427 5478		3525 940586	130 3655 940586
Waterford	9992 063492	8800 199		1191 864149	164 1027 864149
	Profit/Loss				
Total	923683 2173	354476 54		569206 6798	10126 579332 6798

Figure .4 above

## 6.0 Discussion and Conclusion

### 6.1 Discussion

Firstly both trading strategy returned a profit, which the literature pointed out both would. The main discussion is which strategy yielded the greater return. Out of the fifty-six stock the Moving Average yielded a greater return in thirty-three individually compared to the Buy-and Hold's twenty-three. However the key point in testing for the null hypothesis was the overall profitability. Overall the Buy-and-Hold yielded €569,206.67 more than the Moving Average. This was even before transaction costs were taking into account. Using these findings the null hypothesis can be rejected in an Irish Stock Market context,

1 Null Hypothesis  $H_0$ : Moving Averages consistently yield higher returns (after transaction costs are taking into account), on average, than a simple buy-and-hold trading strategy.

We then turn to the alternative,

2 Alternative Hypothesis  $H_a$  (one tailed): Moving Averages consistently yield lower returns (after transaction costs are taking into account), on average, than a simple buy-and-hold trading strategy.

Using the findings as evidence, it is can be said that Moving Averages consistently yield lower returns (after transaction costs are taking into account), on average, than a simple buy-and-hold trading strategy in an Irish Stock Market context.

Having given evidence for the null hypothesis being rejected, out of the fifty-six stocks the Moving Average yielded a greater return in thirty-three individually compared to the Buy-and Hold's twenty-three. So what if the stocks that yielded relatively huge amounts was removed from the data? Even though there was a greater number of stocks that returned profit in the moving average strategy compared to the buy-and-hold, the actual volume of returns made up for the lower number returning a profit than a loss. So there could be further discussion on what is deemed to be the average within the hypothesis.

Assuming the average is the overall return of all the stock divided by the number of stocks, then the null can be rejected. Thus, the alternative comes into the discussion. Similar to the study of Felt (2012) this study finds the 10/20 Day moving average convergence/divergence is profitable in the Irish Stock Market even after transactions costs. However in this study a total of €560,000 was used, maybe this amplified the returns. Would an average investor have this amount of money?

Similar to the studies of Wilder (2009) and Van Horne & Parker (1967), this study concurred that Moving Averages consistently yield lower returns (after transaction costs are taken into account), on average, than a simple buy-and-hold trading strategy. Discussion could arise from this as what does one define as consistently. This study selected fifty-six stocks, the number of individual losses outweighed the number of individual profits but still managed to yield a profit. Consistently neither happened, however overall a profit was made on both strategies.

## 6.2 Conclusion

The limitations of this study included, technical trading rules were limited in the testing. Only Moving Averages were used, however Moving Averages are the most frequently used by technical analysts. Another limitation of this study was lack of investing opportunities for the cash that is held when not invested in the market. The reason for not assuming an investment opportunity for cash was that the margin between the balances of the Buy-and-Hold method and Moving Averages was great.

As there was evidence for alternative hypothesis from the results, this empirical research supports the Random Walk Hypothesis and the Efficient Market Hypothesis, as it was more lucrative to use the buy-and-hold method over technical trading rules.

As only one technical trading rule was used, professional investors would several in conjunction with Moving Averages, so this study does not imply that selection a trading rules would not beat the Buy-and-Hold trading strategy. As Moving Averages returned a profit this could be seen as evidence for stock price predictability within the Irish Stock Market. Regarding Moving Averages, as the Efficient Market Hypothesis stated it impossible to beat the market. So for an inexperienced investor, a Buy-and-Hold strategy would be deemed more appropriate as a tool for yielding a return from the Irish Stock market.

For further studies, it would be recommended to test moving averages on classified stocks in the Irish Market. An example of this would be to test low cap size stocks and compare them to high cap sized stocks. Another recommendation would to

test trading rules on emerging markets as these seem to be less efficient than the ISEQ

## **4.7 Ethical Issues**

The research was conducted in a teleological view which meant that the act of conduct within this research is justified by its consequences, thus no ethical consequences arose from the access to the stock price data from the ISEQ (Saunders, 2006) Also there was no human subjects in this research, however all data that it used will be confided on a confidential computer My duty within this research was to represent the data honestly and also to extend this honesty to the analysis and reporting stage of the research

## **List of Stocks**

**Figure 5 0 (Below)**

ABBY PLC ESM
AER LINGUS GROUP PLC
AGI THERAPEUTICS PLC - ESM
ALLIED IRISH BANK PLC - ESM
ALPHYRA GROUP PLC
AMINEX PLC
ANGLO IRISH BANK CORPORATION PLC
ARCON INTERNATIONAL RESOURCES PLC
ARNOTTS PLC
ARYZTA AG
BALMORAL INTERNATIONAL LAND PLC – ESM
BANK OF IRELAND
BARLO GROUP PLC
C&C GROUP PLC
CPL RESOURCES PLC – ESM
CRH PLC
DATALEX PLC
DCC PLC
DONEGAL CREAMERIES PLC – ESM
DRAGON OIL PLC
ELAN CORPORATION PLC
FBD HOLDINGS PLC
FYFFES PLC – ESM
GLANBIA PLC

GREENCORE GROUP PLC
HORIZON TECHNOLOGY GROUP PLC
I W P INTERNATIONAL PLC
IAWS GROUP PLC
IFG GROUP PLC
INDEPENDENT NEWS & MEDIA PLC
IONA TECHNOLOGIES PLC
IRISH CONTINENTAL GROUP PLC
JURYS DOYLE HOTEL GROUP PLC
KENMARE RESOURCES PLC
KERRY GROUP PLC
KINGSPAN GROUP PLC
MCINERNEY HOLDINGS PLC
OAKHILL GROUP PLC – ESM
ORMONDE MINING PLC – ESM
OVOCA GOLD PLC – ESM
PADDY POWER PLC
PERMANENT TSB GROUP HOLDINGS PLC – ESM
PETRONOFT RESOURCES PLC – ESM
PROVIDENCE RESOURCES PLC – ESM
QUALCERAM SHIRES PLC
READYMIX PLC
RYANAIR HOLDINGS PLC
SITESERV PLC – ESM

SOUTH WHARF PLC
THIRDFORCE PLC – ESM
TOTAL PRODUCE PLC – ESM
TVC HOLDINGS PLC – ESM
UNIDARE PLC
UNITED DRUG PLC
VIRIDIAN GROUP PLC
WATERFORD WEDGWOOD PLC

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