



School of Management

Analysis of Moving Average Convergence Divergence (MACD) as a Tool of Equity Trading at the Karachi Stock Exchange

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S.A

ABSTRACT

The study is an effort to analyse Moving average Convergence Divergence (MACD) as tool of equity trading at the Karachi Stock Exchange. Technical Analysis is one of the methods that provide basis for a decision making in equity trading Moving Average Convergence Divergence (MACD) is one of the variables of the Technical Analysis. Although some earlier studies have been made to understand the MACD Model, such studies have largely been carried out from the perspective of developed Stock Exchanges such as the New York Stock Exchanges. Such studies are useful, however, they often fail to adequately capture the dynamics of the operation of stock trading from the emerging economies such as Pakistan, The theory and literature did not provide any previous study about the MACD Model at the Karachi Stock Exchange. This study aims to address this gap in knowledge by evaluating the Moving Average Convergence Divergence (MACD) as a tool of equity trading at the Karachi Stock Exchange.

The pertinent research question of the study is whether MACD is significant tool of equity trading at the Karachi Stock Exchange. Eleven scrips from different sectors on the Karachi Stock Exchange KSE for the period of three years from 2007 to 2009 is the relevant data for the study. The returns generated by these scrips against Buy and Hold Strategy have been compared with returns of MACD on the basis of Sharpe Ratio. The empirical evidence leads to the inference that MACD is a significant tool of equity trading at the Karachi Stock Exchange. Hence, it was concluded that MACD is informative as it provides basis for decisions making that may lead to value investments in equity trading at the Karachi Stock Exchange. The study is of academic value as it has evaluated the Karachi Stock Exchange, for the first time, in the perspective of MACD. While its practical value is established by the fact that it provides basis for equity trading at the Karachi Stock Exchange.

Chapter 1: Introduction

Decision making about right price to buy or sell a stock is a pertinent question in equity trading owing to the fact that it is the accuracy of the decision that ensures return in this business. The quest of researchers and analysts to develop a viable way of making this decision has led to the rise of different trading tools. Technical Analysis is also included among these tools that comprise of thirty variables including Moving Average Convergence Divergence or simply MACD.

The study is an effort to analyse MACD, variable of technical analysis, as a tool of equity trading at the Karachi Stock Exchange. The choice of MACD and the Karachi Stock Exchange has been made due to the reason that several previous studies are available about the MACD in the perspective of the developed stock exchanges. But, no previous study is available about the Karachi Stock Exchange. This is in spite of the fact that the Karachi Stock Exchange is included among the significant and prominent stock exchanges of the world.

1.1 Research Question

The pertinent research question of the study is whether MACD a significant tool of equity trading at the Karachi Stock Exchange. To investigate the research question, eleven scrips have been chosen at the Karachi Stock Exchange in the period of three years from 2007 to 2009. The returns generated by these scrips against Buy and Hold strategy will be compared with returns against MACD on the basis Sharpe Ratio and conclusion will be drawn in the light of results and findings.

1.2 Research Relevance

The research is of both theoretical significance and of practical value. Keeping in view that most of the researches done in the past 2 decades have been focused on MACD indicator, theoretically, the findings of this study will add to the existing empirical evidence on the effectiveness of MACD as an equity trading tool by exploring trends at the Karachi Stock Exchange. Whilst on a practical level, it will help the investors and traders at the Karachi stock market to make better and informed decisions by using MACD as a tool of equity trading.

1.3 Research Limitation

MACD is an important variable of technical analysis that operates with certain limitations. Since the limitations of MACD have certain practical implications, it is advisable for the traders to evaluate their repercussions. MACD is a study based on interactive charts. The charts have the tendency to give wrong signals, when their formulation is affected due to revaluation of the scrip. Revaluation of the scrip takes place, when bonus or dividend is paid by the company. The traders should analyze the MACD very carefully at this time due to the possibility of wrong signals. Another factor is any news of significant nature, which has the tendency of affecting formation of the MACD. It is advisable for the traders not to confuse news specific trading with MACD, as the same is often not supported by it.

1.4 Karachi Stock Exchange:An Overview

The Karachi Stock Exchange is the oldest and most liquid exchange in Pakistan. Since its inception in 1947, with about 5 companies, its growth has gone up to 652 companies with a market capitalisation of US\$ 30.5 Billion in 2009. As a testament to its performance, it was adjudged one of the best stock exchanges in the world, in 2002. The early 90s saw the introduction of the KSE 50, however as a result of the

considerable growth noticed in the stock market, a more representative index was introduced in 1991 – KSE 100. This index, which is still the most accepted measure of trading, became the benchmark for price comparison on the Karachi Stock Exchange. As a means of ensuring a comprehensive market representation, the KSE100 index was computed by incorporating the companies with the highest market capitalisation in every sector within the market. Following the KSE 100, the KSE-All share index was formulated in 1995 to revalidate the KSE 100 and also serve as the basis of future index trading. (www.kse.com.pk)

Like most exchanges, the history of KSE indicates several critical dates: In April 20, 2008, KSE achieved a significant landmark by crossing the psychological level of 15,000 to peak at 15,237. This feat resulted in an increase of 7.4%, thus making KSE the best performer among emerging markets for that year. Disparate to this success, KSE suffered a gradual bearish trend in May 2008, due to a record high inflation. This situation prompted an increase in interest rates by the State Bank of Pakistan which consequently resulted in an abrupt fall in KSE. The highlight of this fall was noticed in July 2008 when the KSE 100 index dropped one third from its all time high in April 2008. The crisis became so severe on August 28, 2008 that the Karachi Stock Exchange set a floor for prices to halt a plunge that had wiped out \$ 36.9 billion of market value since April. The normal trading activity at the Karachi Stock Exchange was resumed on December 15, 2008 after the removal of floor on stock prices. These fluctuations prompted our decision to choose the period from 2007 to 2009 as our study period. (www.khistocks.com.pk)

Chapter 2: Theory

2.1 Technical Analysis

Technical analysis is a technique which utilises patterns of price history of a financial instrument (commodity, currency, stock or composite average) in order to provide indications on the future behaviour of prices (Caginalp and Balevonich (2003)). Griffioen also explains it as the method by which forecasts are attempted to be made on the basis of past observations and historical prices.

The first application of technical analysis was in Japan, during the 18th century, in the form of candlestick techniques. Since that period, technical analysis has undergone several evolution; notable amongst them is the “Dow Theory”, which is attributed to the works of Charles Dow (*Nison, 2001, pp.15-18*). Although the inception of the technical analysis dates way back, many analysts attribute the ground model for modern day technical analysis to the Dow Theory (Geng and Wang (2009)). The theory was derived from a compilation of 255 Wall Street journal editorials written by Charles Dow in the 19th century. In these editorials, Dow surmised a series of theories on how to profitably trade stocks and also highlighted the disposition of the stock markets. On the later, he stated that: *"The market is always to be considered as having three movements, all going on at the same time. The first is the narrow movement from day to day. The second is the short swing, running from two weeks to a month or more; the third is the main movement, covering at least four years in its duration."*(Dow, 1900 cited by William Peter Hamilton 1922, p.30) - A philosophy widely utilised by technical analysts. Despite the widely utilised premise of this theory, Cowles(1933), based on his study on econometrica, questioned the profitability of Dow theory by concluding that trading based on the theory would have resulted in annualised return of 12% compared to 15% if trading is based on a buy and hold strategy. (www.investopedia.com)

In the addition to the above definitions, scholars in recent times have refined the definition of technical analysis - Prings (2002, p.2-3) defined the method as an art: *"To identify a trend reversal at a relatively early stage and ride on that trend until the weight of the*

evidence shows or proves that the trend has reversed.” Whilst Murphy (1999, p.1) defines it, “*as the study of market action, primarily through the use of charts, for the purpose of forecasting future price trends.*” (Geng and Wang (2009)).

As a testament to the acceptance of this form of analysis among practitioners within the financial field, Allen and Taylor (1990&1992) conducted a survey on behalf of the Bank England among the chief foreign exchange dealers based in London, in 1988. Their results indicated that at least 90 percent of respondents use technical analysis to inform their trading decisions. Further surveys by Cheung and Chinn (2001) indicated that 30% of the US foreign exchange traders utilise technical analysis as opposed to 25% that utilise fundamental analysis. Finally, surveys by Billingsley and Chance (1996) shows that many commodity trading advisors (CTAs) and hedge funders depend on computer guided trading systems which are based on technical analysis in their decision making.

Despite the widespread use of technical analysis, there is an overwhelming scepticism regarding its use among academicians. Some of the reasons for this misconception are:

- According to academic finance, technical analysis is “voodoo finance” as it comprises of several variables which unlike quantitative finance are not measurable. Notable among the academic views were Fama’s Efficient Market Hypothesis (EMH) theory and Malkiel’s Random Walk theory, which out rightly debunks the profitability and creditability of technical analysis. Malkiel (1996) further emphasised this opinion by asserting that “*under scientific scrutiny, chart-reading must share a pedestal with alchemy*”. (Griffioen,2003)
- The charting techniques are difficult to justify theoretically, and are normally expressed in jargons that are alien to academics. (Campbell, Lo and MacKinlay,1997)

Although the academicians discredit the profitability of technical analysis, recent empirical surveys are replete with supporting evidence on the profitability of technical analysis. Some of these research works will be summarised in section 2.11

2.2 Principles of Technical Analysis

Technical analysis studies the price movement on the market by means of analyzing three market factors: price, volume and open interest, of these three factors the primary one for technical analysis is the prices, while alterations in the other factors are studied mainly to confirm the correctness of an identified price trend. Like any other theory, technical analysis has its core postulates, these are:-

- **Market action discounts everything** (Murphy, 1999):

This is the most important postulate of technical analysis. The gist of this axiom is that any factor (information) that influences the price of securities, whether economic, political or psychological, is already incorporated in the stock prices.

- **The prices move with the trend** (Murphy, 1999):

This assumption is the basis for all methods of technical analysis, as market that moves in accordance with trends can be analyzed, unlike a chaotic market. This postulate states that the price movement as a result of a trend has two effects. The first one implies that the current trend will most likely continue and will not reverse itself, thus, excluding disorderly chaotic movement of the market. Whilst the second one implies that the current trend will go on until the opposition trend sets in

- **The history repeats itself** (Murphy, 1999):

Technical analysis and studies of market dynamics are closely related to the studies of human psychology. Thus, the graphical price models identified and classified within the last hundred years depict core characteristics of the psychological state of the market. First of all, they show the moods currently prevailing in the market, whether

bullish or bearish. Since these models worked in the past. One has the reason to suppose that they will work in the future, for they are based on human psychology which remains almost unchanged over years. In a nutshell, this postulate can be worded as: the story repeats itself. Thus the key to understanding the future lies in the studies of the past.

2.3 Types of Technical Analysis

Although there are several technical analysis techniques, analysts have traditionally resorted to two main forms: Charting method and Mechanical (indicator) method. Charting, which is the oldest among the two, comprises of graphing historical data over a specified period of time. This method is subjective in that there is no defined procedure for undertaking the pictorial analysis, thus analysts resort to using their own judgement to predict future patterns. On the other hand, the mechanical method is considered to be a more consistent way, which imposes discipline on the analyst by requiring him to utilise mathematical rules to undertake future predictions.

Economists have favoured the mechanical method approach over charting as it eliminates the issue of subjectivity. Within the equity market, the most studied technical rules are: Filter rule, Moving Averages (MA) and Channel. In general:-

- the filter rule indicates a buy (sell) signal whenever prices rises (falls) by more than a given percentage from its most recent low(high).
- MA rule basically compares a short and a long moving average of past prices and spawns a buy (sell) signal if the short moving average intersects the long moving average from below.
- A channel advices to buy (sell) the asset when its prices exceeds (is less than) the maximum (minimum) over the previous n days.

In addition to the above traditional rules, in recent custom, analysts have become more inclined to utilise newer indicators that utilise mathematical functions to ascertain when to buy or sell (Clement, 2010). Some of these rules are: Relative strength indicator (RSI); Exponentially weighted moving average (EWMA); Moving average convergence divergence (MACD); and Rate of change (ROC). (Nelly and Weller, 2011)

2.4 Moving Average Convergence Divergence (MACD)

Developed by Gerald Appel in the late seventies, Moving Average Convergence Divergence (MACD) indicates the correlation between two price moving averages. MACD is the difference between a 26 day and 12 day Exponential Moving Average (EMA). 12 day MACD is faster and responsible for most MACD movement, while 26 day is slower and less reactive to price changes in the underlying security. In order to clearly show buy / sell opportunities, a so called signal line (9-period indicators moving average) is plotted on the MACD chart. The MACD proves most effective in wide – swinging trading markets. MACD is one of the simplest and most effective momentum oscillator available. The MACD fluctuates above and below the zero line as the moving averages converge, cross and diverge. Because the MACD is unbounded, it is not particularly useful for identifying overbought and oversold levels.(www.stockcharts.com)

2.5 Efficient Market Hypothesis

The EMH theory, is generally concerned with whether prices at any point “fully reflect” all available information (Fama 1970). According to the theory, there are no excess profits to be made by trading on any information, since that information would have already been priced in (Jensen 1978, p96).Thus rendering technical and fundamental analysis obsolete. The burgeoning of this theory could be attributed to Fama. However, Fama (1970) first developed it by reviewing previous empirical

studies such as Samuelson's influential paper, "Proof that properly anticipated prices fluctuate randomly", in which he opined that it is not possible to exploit any information set to predict future price changes; and the statically concluded assessment, within the financial market, that successive price changes are independent. Fama (1970) after his review concluded there were extensive evidence in support of EMH and that contradictory evidence was sparse. Further to this, he also postulated the three (3) forms of efficient market, namely:

Weak form efficiency – in this market, all historical prices is incorporated in current prices. Hence technical analysis yields no predictability or profitability. Tests within this markets prior to the 1970s was mainly focussed on evaluating whether historical prices could be utilised to predict future prices, however recent studies within the area have been focussed on the predictive abilities of financial ratios and interest rates (Fama, 1991)

Semi Strong Efficiency – this is where all previously public information has been aptly incorporated in the stock prices. Fama noticed that in this market, price changes subsequent to new information were instant. As a result of this phenomenon, fundamental and technical analyses are useless within this market. According to Fama, the current stock market is reflective of this kind of market.

Strong Form efficiency – the basic premise of this market is that no investor has superior ability over the market, and thus it is improbable to beat the market in any way. The test is mainly concerned with whether all information privy to the public and private groups have been incorporated in the stock prices. Several studies within this market have focussed on whether certain groups with information monopoly can utilise it to their advantage to gain excess returns (Elton et al, 2007, p.402). According to Fama, the stance of this theory rocks "*the reason d'être of mutual funds, portfolio managers, equity analysts as well*

as the practice of fundamental analysis at its very core, as their proficiencies and merits are considered temporary at best” (Erlesand and Orn, 2011).

In addition to Fama’s work, Shleifer (2000,p.2-3) propounded three assumptions as the premise for the EMH theory as follows:

- Investors are rational, in that they undertake fundamental analysis, way up the expected risk and return of each stock before making any investment. Suggesting that rational investors are basically professional economists.
- Where there are irrational investors, their trading activities are random. According to this assumption, the market belongs to rational investors; because the activities of irrational investors end up nullifying each other.
- “Market arbitrage can correct price when it deviates from its efficient level. Because both investors are rational, they will do the arbitrage once the there are imbalances existing in stock prices. Through this way, stock price will always stay in an efficient level.” (Geng and Wang, 2009)

2.6 Random Walk Theory

The random walk theory states that stock prices have the same distribution and are independent of each other. As such previous movements, trends of stock prices and market reaction could not be used to ascertain future movements. According to the model, the behaviour of stock prices is akin to random walk, in that its disposition is completely unpredictable. The theory completely buttresses the efficient market hypothesis, in that the effects of new information on prices are considered haphazard and independent.

Apropos to technical analysis, the theory concludes that since prices movement are completely random and unpredictable, the study of historical patterns is completely futile. According to Fama, there are extant empirical data which confirms this theory, thus the onus is upon chartist to prove that technical analysis do result in excess profits. (Fama, 1995). This view is also supported by Malkiel. In his book “A Random Walk Down Wall Street” he opined that both technical and fundamental analysis are a complete waste of time and cannot outperform the market.

It should however be noted that despite there being enough supporting evidence on the random walk theory, as already opined, recent research also contradicts this theory.

2.7 Behavioural Finance

Behavioural finance is the study of the influence of psychology on the behaviours of financial practitioners and the subsequent effect on markets. (Sewell, 2005)¹This branch of modern economic theory opposes the EMH theory by explaining how and why a market might be inefficient, and also the irrational behaviour of traders. This relatively new field of finance focuses on using psychology to understand the behaviour of traders with the sole purposes of explaining market movement.

Disparate to the EMH theory, behavioural finance is the underpinning of technical analysis (Flanegin and Rudd, 2005). Proponents of this theory have generally debunked the assumptions of EMH theory. For a example Thaler (1980) argues that weaknesses such as overconfidence, loss aversion and other biases most often causes consumers to behave in an irrational manner. Further to this, he opines that the market comprises of both rational investors and quasi – rational investors, thus if a market is dominated by quasi-rational investors, the market will consequently shift from its efficient level. Both beliefs thwart the very core of the EMH theory. Fundamentally,

¹ (<http://introduction.behaviouralfinance.net/>).

behavioural finance espouses that these irrational behaviours results in trends which are predictable – a stance totally different from the EMH proponents.

The main critics of this theory have emanated from the proponents of the EMH theory who argues that this branch of finance cannot be lauded primarily because it is believed that the “theoretical behaviour models are ad hoc and designed to explain specific stylised facts”. But like Thaler (1999) said -

“Behavioural finance is no longer as controversial a subject as it once was. As financial economists become accustomed to thinking about the role of human behaviour in driving stock prices, people will look back at the articles published in the past 15 years and wonder what the fuss was about. I predict that in the not-too-distant future, the term “behavioural finance” will be correctly viewed as a redundant phrase.” – This theory has indeed been entrenched the financial world, thus the question remains however that which theory is superior?

2.8 Previous Studies

The following section gives a summarised account of some research work conducted on the use and effectiveness of technical analysis:

Other evidences of the predictive power of technical analysis: the moving averages rules on European indexes.

Authors: Detry, Gregoire

The paper aimed to evaluate the forecast power of technical rules on the European indexes utilising daily data to replicate Brock, Lackonishok and LeBaron (BLL thereafter) (1992).

The authors evaluated the 10 VMA (variable length moving averages) rules of BLL, which primarily consist of comparing short moving average of price with long moving averages. Hence the authors evaluated the following VMA: (1,50,0), (1,150,0), (5,150,0), (1,200,0), (2,200,0), (1,50,0.01), (1,150,0.01), (5,150,0.01), (1,200,0.01), (2,200,0.01), where the first and the second figure represent the number

of days over which the short and long moving averages were computed, respectively, with the third figure representing is the value of the band.

The authors explained their reason to investigate the VMA and not FMA (Fixed length moving averages) nor TRB (Trading range break-out) stemmed from the fact that the results obtained by the VMA rules in BLL were more significant.

In order to avoid the issue of data snooping bias, the authors decided to test the 10 rules on all the 15 countries within the European Union. The chosen indexes were based on the following formal procedure:

- In datastream, on the index page, they selected all the indexes beginning with the name of the country (in English).
- Then, they selected the index for which the records begin the most early. When several indexes start at the same date, they simply chose the first in alphabetical order.

Their evaluation was done utilising a simple statistical t-test and the bootstrap methodology based on BLL. Following this, the authors made the following conclusions: -

- In 13 out of the 15 cases, the VMA rules showed some predictive ability in the sense that returns following buy signals are higher than the returns following sell signals.
- In 11 cases, the predictive power of the VMA rule was statistically significant.
- In 10 cases, the result was robust to risk adjustment
- With respect to volatility, the author concluded that, in 9 out of the 15 cases, the technical rules showed significant ability to select risky periods.

Is technical analysis profitable on U.S stocks with certain size, liquidity or industry characteristics?

Authors: Martin Young, Sun Qian, Ben R. Marshall (2007)

The paper investigated whether technical trading rules had any profitability impact on the US stock market. The authors consented to the existing knowledge that technical analysis on the broader scale were generally not profitable, however the main premise of their study was to assess whether the popularity of technical trading rules among practitioners was due to their profitability on a small subset of stocks with certain size, liquidity and industry characteristics. They examined individual NYSE and NASDAQ stock data over the entire period of 1990 to 2004. This resulted in 866 stocks listed on the NYSE and 199 stocks listed on the NASDAQ being evaluated.

The authors undertook their evaluation by testing for the statistical significance of the trading rule profits on the individual stocks by utilising both t-tests and a bootstrapping methodology with much focus on the later. The technical trading rules examined were: the variable moving average (VMA); the fixed length moving average (FMA); and the trading range break-out rule, (TRB). For each these rules, the short term was set at one trading day and the long term at 50, 100, 150, and 200 trading days.

In the addition to their chosen methodology, they treated each firm as a Bernoulli trial with the null of zero profits/no predictive power and a probability of that outcome being 50%. This the authors explained allowed them to test the statistical significance of the null hypothesis that the trading rules do not generate positive returns on more stocks than would be expected by chance.

The paper concluded that the studied technical rules were not profitable when applied to the vast majority of stocks and that the result was robust to the different time periods and different markets i.e. NYSE AND NASDAQ. However, in instances where the trading rules produced statistically significant profits on a stock, the profits were inclined to be greater for the longer decision period rules. Additionally, the

profits were often considerably larger than reasonable estimates of transaction cost. Thus suggesting the reason why practitioners continue to utilise technical analysis despite not generating profits on a consistent basis.

Despite the above, the authors also noted that there was evidence that the trading rules were more profitable on small and liquid stocks but rebuffed the evidence as not being strong enough.

Technical Analysis with a Long-Term Perspective: Trading Strategies and Market Timing Ability

Authors: Dušan Isakov, Didier Marti (2011)

The paper presented new evidence to rebuff the dithering confidence in the predictive power of technical analysis and consequently its profitability as shared in academia. The authors had 3 main objectives. First, they evaluated trading systems based on moving average rules that were not restricted to forecast short-term trends as done conventionally. Secondly, they proposed new market timing test based on simulations to assess whether the new trading strategies were more inclined to follow long-term trends in the market. Thirdly, they evaluated the impact of the trading strategies with financial leverage. The research was performed on the S&P 500 index, utilising all daily closing prices spanning from the period of January 1990 to December 2008.

In this paper, the authors aggregated the information provided by the simple MA rules into complex trading rules. Citing the following reasons as the pros for their decision:

- Complex trading rules utilises more information and
- Complex trading rules eliminate subjectivity in the selection of parameters.
- It restricts the effects of data snooping

The authors indicated that the process of manipulating the data obtained from the simple rules into their utilised complex trading rules closely mirrored those proposed by Hsu and Kuan (2005). The outcome of their investigation showed that the complex trading rules depicted high proportion of accurate signals.

On touching the issue of market timing, the authors highlighted that the commonly used short-term test had a high propensity to misinform on the market behaviour on the trading strategies that follow long-term trends. Hence they proposed a test that assessed whether the trading strategy is able to spawn positions consistent with the market phases instead of daily returns be rather used.

The paper concluded that complex moving averages are able to detect and take advantage long-term markets movements thus challenging the efficient market hypothesis. Saying that, it is worth mentioning that, the authors acknowledged 2 limitations with their results. First, their results were not statistically tested and secondly, whether the results will hold for other markets.

Testing for predictability in Emerging equity markets

Author: Chang, Lima, Tabak (2004)

Following the work by Brock et al. (1992), the authors utilised the moving average trading technique to evaluate whether technical analysis possessed the capabilities of forecasting price change in a series of emerging stock markets. Their decision to assess the moving average was based on the immense popularity of this trading strategy in several research works. The following lengths were adopted for their analysis: 1-50, 1-150, 5-150, 1-200 and 2-200.

The analysed data set comprised of indices from Argentina, Brazil, Chile, India, Indonesia, Malaysia, Mexico, the Philippines, South Korea, Taiwan, Thailand, Japan and the U.S for the entire period of January 1991 to January 2004.

Like many research works, the assessment was done utilising the bootstrap methodology. From their assessment, the MA strategy predicted an annual excess return of 3.35% for the emerging markets. However, the technique also showed superior returns for markets such as Malaysia and the Philippines.

From their results, the authors concluded that technical analysis possessed minimal forecasting abilities with exception of certain markets. On the issue of profitability, the authors indicated the prior to their research technical analysis was considered profitable in the Mexican market; however during their research period there was no evidence in support of this. The authors attributed this phenomenon to the fact that the trading rules had become widely known and utilised.

Simple Technical Trading Rules and the Stochastic Properties of Stock Returns
Authors: Brock, Lakonishok, LeBaron (1992)

This paper evaluated two of the simplest and most popular trading rules-moving average (variable length moving average (VMA) and Fixed length moving average (FMA)) and trading range break (TRB)-by utilizing the Dow Jones Index from 1897 to 1986. These rules were tested by their ability to predict future stocks. In assessing the moving average rule, the authors chose the following lengths based on their popularity with practitioners: 1-50, 1-150, 5-150 and 2-200. The authors further modified the rule by introducing a 1% band around the moving averages to eliminate “whiplash” signals when the short and long period moving averages are close.

According to the paper, the variations between daily returns of buy and sell signals portrayed by the VMA were all positive and statistically significant, thus rebuffing the null hypothesis of equality, i.e. of the rule not being able to deliver any excess returns. The authors also indicated that both the average one-day return given by buy-signals and sell-signals were statistically significant on the 5% level.

Aside using the 90 years data collated, for the Dow Jones Industrial Average, the bootstrapping methodology was also utilised to simulate additional data which enabled the authors to test statistical inferences. The simulations were done based on the following models: a random walk with a drift, auto-regressive process of order one (AR(1)), generalized autoregressive conditional heteroskedasticity in-mean model (GARCH-M), and Exponential GARCH (EGARCH). Subsequently, the returns conditional on buy (sell) signals using the raw Dow Jones data was compared to conditional returns from simulated comparison series. The authors revealed that models could not replicate the returns generated by the Dow Jones data.

The paper concluded that the results provided strong support for technical trading rules, and showed that the rules also had strong predictive capacities, although transaction costs could diminish potential returns.

Technical Analysis Around the World

Author: Ben R. Marshall*, Rochester H. Cahan, Jared M. Cahan(2010)

The paper investigates the profitability of technical trading rules in the 49 developed and emerging market indices that make up the Morgan Stanley Capital Index (MSCI). In doing this, the authors assessed daily MSCI data spanning from January 2001 to December 2007. The decision to work on the MSCI indices was based on these being the benchmark adopted by asset managers around the world.

The authors employed the most popular data snooping methodology based on Sullivan, Timmermann, and White (1999), for their research. However, due to the criticism that this methodology is overly sensitive to the inclusion of underperforming rules, they subsequently followed Marshall, Cahan and Cahan (2008) to check how sensitive their conclusion were to the size of the rule universe. They also incorporated the bootstrapping methodology utilising the GARCH-M null model.

According to the authors, their results from the over 5000 trading rules from four rule families i.e. filter rules, Moving averages rules, support and resistance rules and channel break-outs considered indicated that:

- technical analysis works better in emerging market
- technical trading rules do not consistently add value when applied to broad range of intentional markets

2.9 Hypothesis

According to the weak form of efficient- market hypothesis and the random walk theory :

- The current price of a stock is reflective of historic data. Thus it is futile to study historic data since its effects are already embedded in the current price of a stock at any point time.
- The distribution of a stock is the same and independent of any information.

Based on this, we formulated this hypothesis under the premise that if the weak form of market – efficiency and the random walk theory is right then the returns generated by the MACD should be the same as that generated from the passive strategy (unconditional returns i.e. daily returns of our portfolio). However if the returns generated are different it then suggest that MACD is significant as it can predict price changes i.e. it captures scenarios/trends - an assertion that rebuts the weak form of market – efficiency and the Random Walk theory.

Thus we compare the distributional characteristics of the conditional and unconditional returns to assess whether or not technical analysis can predict market changes.

At the same time, the disequilibrium pricing models, alludes to fact that markets are usually in an efficient state, however in the wake of an “informational shock”, the market tends to go into a state of disarray as a result of investors changing their

perception about the true value of a stock. The theory proposes that this state of confusion (inefficiency) results in price disequilibrium which can be exploited by assessing price trends to make profits. Conversely, according to Fama's EMH theory, the market behaves in a random manner thus the use of technical analysis is completely futile – a stance which he argued was propped by extant empirical evidence. To this effect there have been several works to rebuff this opinion most of which have been done by assessing the MA indicator. However since our calculation does not inculcate transaction cost, we shy away from deeming it a profitability test . To assess this we compared the returns generated from the buy/hold strategy to that generated from the Moving Averages. The buy/hold strategy was chosen as our benchmark as this is the nature of most traders.

Chapter 3: Method

In order to analyse MACD as a tool of equity trading at the Karachi Stock Exchange, data from 11 selected scrips within KSE, for a period of three years - 2007 to 2009 will be analysed.

3.1 Research Strategy

Research strategy generally refers to the way by which business research are conducted (Bryman and Bell, 2007). There are basically two main approaches:

- The qualitative approach - this is more subjective in nature. It involves examining and reflecting on perceptions in order to gain an understanding of social and human activities (Hussey and Hussey, 1997, p.12). According to (FHI, 2009), qualitative research is especially effective in obtaining culturally specific information about the values, opinions, behaviours, and social contexts of particular populations.
- The quantitative approach - this involves collecting and analysing numerical data, and applying statistical tests (Hussey and Hussey, 1997, p.12). With this kind of research strategy the relationship between theory and research is viewed to be deductive in nature (Ekpoudom, 2009).

As side these methodologies, is the case study approach. According to Yin (2009), this methodology is the most suitable approach when a research question is based on “how” – In our case – How significant is MACD as a tool in equity trading? Thus, based on the appropriateness and strength of these approaches, both the “case study” and “quantitative” approach have been employed for our study.

3.2 Sample

In order to achieve a good reflection of the Karachi Stock Exchange from this study, it was imperative that we ensure most of the sectors trading on KSE were given adequate and appropriate representation, especially because it was not possible to take into account all the scrips of the Karachi Stock Exchange. Thus, prompting the issue of sample and sampling.

Sample is the part of population that is chosen in the belief that it truly reflects the characteristics of the population. Because the leading research question was to evaluate MACD as a tool of equity trading while investigating Karachi Stock Exchange on a case study basis. The population for the study was deemed to be the two main variables - Karachi Stock Exchange and MACD of the selected scrips.

3.3 Choice of 11 Scrips

After deciding that 11 scrips of KSE will be incorporated in our research, we aggregated the scrips at the Karachi Stock Exchange into trading sectors. This was to ensure that our chosen scrips encompassed all business sectors on KSE. Further to this, we also endeavoured to include the important and liquid scrips from each of the sector. The following is sector wise breakup of our studied scrips:

➤ **Banking Sector:**

- MCB(MCB Bank Limited)

➤ **Oil Marketing Sector:**

- PSO(Pakistan State Oil)

➤ **Oil Exploration Sector**

- MARI(Mari Gas Company Limited)

➤ **Cement Sector**

- LUCK(Lucky Cement Limited)
- **Fertilizer Sector**
- ENGRO(Engro Fertilizer Company Limited)
- **Textile Sector**
- DSIL(DS Industries Limited)
- **Technology Sector**
- NETSOL (Netsol Technologies Limited)
- **Insurance Sector**
- PAKRI(Pakistan Reinsurance Company Limited)
- **Chemical Sector**
- ICI(ICI Pakistan Limited)
- **Paper and Board Sector**
- PKGS(Packages Pakistan Limited)

3.4 Choice of MACD

Technical analysis at the Karachi Stock Exchange comprises of 40 variables that also includes variables with weak explanatory power. The study has been conducted on the basis of Moving Average keeping in view the fact that it is considered as the most important variable of technical analysis and majority of the studies have been conducted on the basis thereof. The choice of MACD has been made while keeping in view its frequent and common use in the previous studies.

3.5 Market Index

It is pertinent to mention that KSE-100 index was chosen as a market index for the study while leaving aside the following other indexes:

- i. I .KSE All Share Index
- ii. KSE -30 Index
- iii. KMI-30 Index

This is due to the obvious reason that KSE-100 index is the most commonly used index for the Karachi Stock Exchange as compared to the other three that are not that much popular.

3.6 Data

The data set for our hypothesis consist of the closing daily prices for the 10 scrips and index from the period of January 2007 to December 2009. The historical data is available at www.kse.com.pk. We utilised technical analysis software (in a form of interactive charts) linked to www.ksestocks.com to generate buy/sell signals based on MACD. In order to investigate the hypothesis that MACD is a significant tool of equity trading at the Karachi Stock Exchange , comparison of returns on the basis of MACD and Buy Hold Strategy has been made and is described in detail.

3.7 Return Frame Work

The returns were calculated as follows

$$X_t = \frac{P_t - P_{t-1}}{P_{t-1}} \quad (\text{eqn 3.1})$$

Where:

P_t – sell Price (daily closing Price)

P_{t-1} – buy Price (daily closing Price)

X_t - Return

The statistical property of daily returns for scrips are shown in the table below:

	Mean	K-S Normality Test	Kurtosis	Skewness	Count
MARI	0.000925	0.000	53.093	-3.898	651
PSO	0.000284	0.000	1.755	-0.243	698
ICI	0.000877	0.000	0.025	0.061	681
ENGRO	0.000662	0.000	93.281	5.541	692
PAKRI	-0.00012	0.000	96.717	-6.242	681
NETSOL	0.001067	0.000	5.719	0.219	695
DSIL	-0.00188	0.000	14.504	0.430	638
PKGS	-0.00021	0.000	0.121	0.077	671
MCB	0.000282	0.000	-0.247	0.060	692
LUCK	0.000582	0.000	0.671	0.102	683

K-S standard for Kolmogorov-Smirnov normality test (p-value)

Table 3 1 Statistical property of daily returns for scrips

From the above table, 5 scrips depicted high kurtosis. The K-S test revealed that the data for all the scrips were not normally distributed. However, because we aim to assess the true performance of our studied technical trading rule, we have refrained from normalising on our data. As a result we have employed a non-parametric test to verify our results when required.

3.8 Sharpe Ratio

The Sharpe Ratio is a widely accepted means of undertaking performance test in today's financial market. It was first formulated in 1966 by William Sharpe as a Reward-to-Variability (R/V) ratio. We utilised this test to ascertain the performance of our studied primary indicators.

In 1994, Sharpe defined the formula as

$$S_p = \frac{E(r_p) - r_f}{\delta_p} \quad (\text{eqn 3.2})$$

Where:

$E(r_p)$ is the expected return of the portfolio p

r_f is the risk-free rate

δ_p is the risk of the portfolio p measured as the standard deviation. (Bodie, Kane and Marcus, 2008,p.219)

However because we are using historical data, the formula has been amended to:

$$S_p = \frac{\bar{X}_t - r_f}{\delta_t} \quad (\text{eqn.3.3})$$

$$S_p = \frac{\bar{X}_b - r_f}{\delta_b} \quad (\text{eqn.3.4})$$

Where

\bar{X}_t and δ_t are the mean return and standard deviation respectively, for an active strategy

\bar{X}_b and δ_b are the mean return and standard deviation respectively, for passive strategy (BUY & HOLD)

Risk free interest Rate (r_f) was estimated as 0.094² per day. This was done by finding the average of the Pakistan T-bill rate for the period of study.

3.9 Explanation

We first calculated the expected return of a buy & hold strategy for the scrips and index. The buy & hold strategy is a passive strategy where the trader/investor buys a financial asset and hold it for a long period of time. For the sake of our calculations, we have assumed a hold period of a year thus the first price of the year has been considered as the “buy” price whilst the last price of the year has been considered as the “sell” price.

Secondly we calculated the expected returns generated by MACD indicator during an active strategy. In undertaking this, we allude to the premise that a trader will buy and sell when the MACD indicator stipulates so.

² <http://www.sbp.org.pk/ecodata/tb.pdf>

To assess this hypothesis, we first and foremost check whether an active strategy yields some form of return (denoted by X_i) and for an additional impetus (not relevant to our research study) whether the expected return is better than the return of a buy & hold strategy (denoted by X_b)

Subsequent to undertaking this relative comparison; we proceeded to calculating the Sharpe Ratio as a means of undertaking a performance test on the primary indicators. We chose this ratio due its wide acceptance in the financial market, and its ease of use.

Chapter 4: Results and Findings

4.1 MACD is Informative

	Mean	Std	Kurtosis	Skewness
^a Securities	0.00025	0.00086	4.132	-1.855
	Trend Indicators			
MACD	0.0961	0.31	15.78	3.17

^aSecurities is an average returns of all securities in the sample.

Table 4.1 Distribution of daily returns

Judging from the moments in the above table, it is apparent that the distributions of the unconditional return differ from that of the conditional return. Thus we conclude that the MACD is informative. Also we noticed that MACD consistently yielded high returns when considering daily return distribution.

Also, we noticed that the Kolmogorov – Smirnov test rejected the normal distribution for the indicators (see table 4.2). Thus this test also supports the contrary to the Random Walk theory the distribution of a stock is not normally distributed.

Indicator	Test Statistic ^a
MACD	0.23

^a test conducted 95% confidence level

Table 4.2 Kolmogorov – Smirnov Normality Test

4.2 MACD Provides Basis for Decision Making

The table below shows the annualised mean return for index and scrips studied in our research. Studying the returns it is obvious that MACD yield returns, however we realised that the returns yielded by the MACD was less than that generated from the traditional Buy& Hold strategy. Saying that, it is worth pointing out that for DSIL the MACD yielded a substantially greater return compared to the BUY&HOLD strategy. Whilst for ENGRO, MACD yielded better returns than the BUY&HOLD strategy.

The relevant point of note is that MACD have yielded positive returns. This led to the deduction that as a tool, MACD is viable since for most case it rewards the trader/investor with some amount of return. On this premise it is fair to say that as a decision making tool, the careful application of MACD can form a basis for value investments.

		TRADING STRATEGY	
		BUY&HOLD	MACD
SCRIPS	DSIL	-46.44%	25.85%
	ENGRO	4.93%	9.70%
	ICI	54.67%	7.62%
	LUCK	48.38%	2.96%
	MARI	35.49%	9.06%
	MCB	26.15%	8.29%
	NETSOL	135.8%	1.27%
	PAKRI	55.83%	1.23%
	PKGS	11.75%	2.08%
	PSO	29.88%	2.45%
INDEX	KSE100	15.30%	2.29%

Table 4.3 Annualised Expected Mean Return

4.3 MACD Leads to Value Investments

The general premise of the sharpe ratio is that it determines the performance of a security by measuring the excess return per unit risk. Thus if an investor is risk averse, trading decision will based on higher returns and low variability of return. From equation (3.3), the higher the ratio the better the performance of the investment.

From the table below, we realised that because the returns for most of the securities were comparatively lower when trading with MACD, than the buy & hold, the sharpe ratios were eventually lower than the ratios for the buy & hold (benchmark). Thus implying that the performance of these variables were lower than the buy & hold

Despite the generally low performance of MACD, the instances of higher performance than the buy & hold lead to the inference that a careful and right application of the variable could yield better performance.

SCRIPS	BUY & HOLD			MACD		
	MEAN	STD	SHARPE	MEAN	STD	SHARPE
DSIL	-0.4644	0.3274	-1.7067	0.2585	0.4438	0.3701
ENGRO	0.0493	0.6041	-0.0745	0.0970	0.0897	0.0296
ICI	0.5467	1.1121	0.4068	0.0762	0.1896	-0.0953
LUCK	0.4838	1.0522	0.3702	0.0296	0.1256	-0.5151
MARI	0.3549	0.9325	0.2795	0.0906	0.0443	-0.0830
MCB	0.2615	0.8152	0.2051	0.0829	0.1205	-0.0944
NETSOL	1.3589	2.9992	0.4217	0.0127	0.0811	-1.0060
PAKRI	0.5583	1.7308	0.2681	0.0123	0.2372	-0.3458
PKGS	0.1175	0.7764	0.0299	0.0208	0.1000	-0.7343
PSO	0.2989	0.9030	0.2266	0.0245	0.0922	-0.7578
KSE100	0.1531	0.6377	0.0922	0.0229	0.0657	-1.0864

Table 4.4: Sharpe Performance Ratio

Chapter 5: Conclusion

The study leads to the inference that MACD is a significant tool of trading at the Karachi Stock Exchange. As MACD is informative to provide basis for decision making that leads to value investments. The finding may be considered as important, if viewed in the light of the fact that it is consistent with previous studies that were conducted in the developed equity markets such as London and New York. This implies that Karachi stock Exchange is similar to its developed counter parts in its intent and nature, where theoretical rules of equity trading are as valid as in other developed markets of the world. The finding may be considered as of practical nature owing to the fact that in Pakistan, there is general impression about the Karachi Stock Exchange that it is often manipulated by the big investors, having the ability to control market trend due to their heavy stake in the market. The study negates the common perception on empirical grounds and establishes that theoretical trading rules are followed at the Karachi Stock Exchange.

The instances of higher returns generated by MACD than the traditional buy and hold strategy implies that its careful application can form a basis for viable and profitable decision making. As such the importance of this study in aiding investors to make informed decisions on KSE cannot be overlooked. Especially as this is first study of this nature conducted on the Karachi Stock Exchange. Further to this, another significance of thesis is that its findings, to some extent, remove the doubts and misperceptions of market manipulation which surrounds equity trading at KSE, as it has been empirically concluded that MACD has the ability to predict price trends at the Karachi Stock Exchange to ensure value investments.

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Annex-A

Analysis of Buy and Sell Signals, KSE-100 Index and Individual Scrips-

S.No	Scrip	Buy MACD	Sell MACD
1	KSE-100 Index	23	24
2	MCB	21	22
3	PSO	22	23
4	MARI	19	20
5	LUCK	28	29
6	ENGRO	31	32
7	DSIL	38	38
8	NETSOL	25	26
9	PAKRI	17	18
10	ICI	26	27
11	PKGS	24	24