Evidence that Weak-Form Capital Market Efficiency Does Not Hold

by

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ABSTRACT

It is generally accepted in academic circles that the developed country capital markets with their advanced infra-structure, depth and liquidity are at a minimum Weak-Form efficient.

Since the Weak-Form EMH proposes that current security prices immediately assimilate all historical information, it therefore also implies that technical analysis (which relies on charts and analysis of past price patterns to extrapolate future price movements) would be a futile exercise. Yet technical analysis has endured over time and is still an intensively and widely used investment analysis technique.

This indicates a clear disconnect between technical analysis as employed by practitioners in the market and the technical analysis methodologies utilized by academics in prior Weak-Form EMH studies.

The problem is prior technical analysis Weak-Form EMH studies were burdened with methodological weaknesses which severely handicapped the profit generating potential of technical analysis and suggest that previous Weak-Form EMH research findings were erroneous in being unable to reject the null Weak-Form market efficiency hypothesis.

This study addresses the problem by eliminating prior methodological weaknesses and utilizing high frequency intra-day data, the combination of qualitative and quantitative techniques and volume signals to develop a portfolio of Intermarket Momentum technical analysis strategies that generate significant excess profits.

The objective of this study is therefore to provide evidence that contrary to prior research findings, the developed country capital markets are not Weak-Form efficient.

The results show that the portfolio of Intermarket Momentum trading strategies generated returns in excess of the market with a significantly positive Alpha of 8.52% that allowed the rejection of the Null Hypothesis and the acceptance of the Alternative Hypothesis that the developed country capital markets are not Weak-Form efficient, thereby refuting the widely accepted EMH.

Key Words: Efficient Market Hypothesis; Weak-Form Market Efficiency; Technical Analysis; Charting; Qualitative Technical Analysis, Quantitative Mechanical Rules; Intermarket Analysis.

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1 ORIENTATION

1.1 Introduction

The Efficient Market Hypothesis (EMH) has been a fertile ground for academic research over the past 50 years: A Google search of the term "Efficient Market Hypothesis" reveals 1.25 million results and over 470 000 peer reviewed Journal articles have been written. Prominent business school University professors Eugene Fama (University of Chicago), Paul Samuelson (Massachusetts Institute of Technology), Michael Jensen (Harvard University), Robert Shiller (Yale University), Burton Malkiel (Princeton University), and Andrew Lo (Massachusetts Institute of Technology) amongst others have dedicated significant portions of their academic careers into research that supports or refutes the EMH[1].

The Efficient Market Hypothesis (EMH) proposes that security prices at any point in time fully reflect all available information (Fama, 1970). As a consequence therefore, exploitable time lags and temporary pricing anomalies should not exist, which from a practical point of view implies that no market participant should be able to consistently generate abnormal returns in excess of the market.

Despite over half a century of research, there is surprisingly still no consensus and the EMH remains to this day a "hypothesis" and has yet to develop into a theorem – a testimony to the contentious nature of the opposing research results which have only served to harden the resolve of proponents for and against the EMH.

1.2 Research Question

Notwithstanding the opposing research results, it is generally accepted in academic circles (Brown, 2011; Ball, 2009; Malkiel 2005 & 2011) that the developed country capital markets with their advanced infra-structure, depth and liquidity are at a minimum Weak-Form efficient.

This view is supported by recent research findings (Pukthuanthong-Le and Thomas, 2008; and Neely, Weller & Ulrich, 2009) that show the significant erosion of trading rule profits as of the mid-1990s, and numerous technical analysis studies (Levy, 1971; Osler and Chang, 1995; Omrane and Van Oppens, 2008; Fama and Blume, 1966; Lee and Sodoikhuu, 2012; Van Landingham, 1980; Dempsey, Hudson & Keasey, 1996; Chen, Huang & Lai, 2011; Jensen and Benington, 1970; Chu, 2003; Coe and Laosethakul, 2010; Sehgal and Gupta, 2007; Chong, Cheung & Wong, 2010; Chen and Metghalchi, 2012; Lam and Chong, 2006; Fisher and Statman, 2006; Fyfe, Marney & Tarbert, 1999; Ready, 2002; Miles and Smith, 2010) that all support the Weak-Form EMH.

Since the Weak-Form EMH proposes that current security prices immediately assimilate all historical information, it therefore also implies that technical analysis (which relies on charts and analysis of past price patterns to extrapolate future price movements) would be a futile exercise.

[1] Eugene Fama and Robert Shiller were joint recipients of the 2013 Nobel Prize in Economics for their EMH research and the empirical analysis of asset prices.

Following the above-mentioned empirical studies which all support the Weak-Form EMH, technical analysis should prove to be a worthless activity, yet technical analysis has endured over time and is still an intensively and widely used investment analysis technique. In fact, in an extensive survey of 200 foreign exchange and international fund managers, Gehrig and Menkhoff (2006) found that technical analysts make up the largest group among foreign exchange traders and the second largest group among international fund managers.

This is a puzzling phenomenon, and begs the question:

Why would the majority of investment fund managers stubbornly persist in utilizing the apparently worthless endeavor of technical analysis?

And perhaps more importantly,

Why would investment banks and mutual funds continue to pay their fund managers multi-million-dollar compensation packages to pursue the nugatory practice of technical analysis?

This indicates a clear disconnect between technical analysis as employed by practitioners in the market and the technical analysis methodologies utilized by academics in prior Weak-Form EMH studies.

1.3 Research Problem

The problem is that all previous technical analysis EMH research neglected to exploit intermarket technical analysis, the powerful combination of qualitative and quantitative techniques, high frequency intra-day strategies and volume confirmation signals in addition to focusing exclusively on individual domestic stock or currency markets.

These issues cumulatively result in methodological weaknesses which severely handicap the profit generating potential of technical analysis and suggest that previous Weak-Form EMH research findings were erroneous in being unable to reject the null Weak-Form market efficiency hypothesis.

1.4 Research Objective

The objective of this study is to utilize high frequency intra-day data, the combination of qualitative and quantitative techniques and volume signals to develop intermarket technical analysis strategies that generate significant excess profits and consequently show that contrary to prior research findings, the developed country capital markets are not Weak-Form efficient.

1.5 Significance of the Study

1.5.1 Modern Finance Theory

The Modern Finance Theory paradigm created over 50 years ago, of which the EMH is the cornerstone, would be challenged and this would encourage future research in Behavioral Finance and strengthen the case for a paradigm shift in price formation theory.

1.5.2 Bank Regulation

Empirical evidence of market inefficiency and consequent inability of the market to manage prices and risk, will strengthen the case of government bureaucrats pushing for more stringent global regulatory standards on the necessary level of bank capital, liquidity and leverage requirements and overall banking industry regulation in the aftermath of the 2008 global financial crisis.

1.5.3 Allocation of Resources

Inefficient capital markets will send inaccurate signals to private and institutional investors regarding their capital investment decisions amongst the nation's private and public companies, and firms will receive inaccurate price signals to guide their strategic production and investment decisions. This will result in the sub-optimal allocation of the nation's resources in unproductive companies, which will have a significant detrimental long term effect on economic growth and prosperity.

1.5.4 Long-Term Investment Strategy

From a long term investment strategy perspective, global capital market inefficiency dictates that it would be a wise choice to select a professional investment manager who is able to capitalize on global market inefficiencies by diversifying and trading internationally, thereby generating returns in excess of the market and a much needed larger nest egg upon retirement.

1.5.5 Business Leadership

The EMH as the cornerstone of Modern Finance Theory and technical analysis as an intensively and widely used investment analysis technique, together constitute vital elements of Financial Management which remains a core foundation course of all Master of Business Administration (MBA) programs[2]. In addition, top business schools place more than 40% of their MBA graduates in the finance industry – former Merrill Lynch CEO's John Thain and Stanley O'Neal, Lehman Brothers CEO Richard Fuld, and *ex* Citigroup CEO Vikram Pandit are all card-carrying MBA graduates (Holland, 2009).

[2] Source: www.wikipedia.org

The banking and investment banking industry are the lifeblood of an economy, the failure of which would pose a systemic risk to which the 2008 world financial crisis bears testimony. Not surprisingly, financial industry executives are the preeminent business leaders in our society responsible for guiding the economy through a constantly changing global business environment.

1.6 Limitations

The availability of historical high frequency intra-day data on the TradeStation platform limited the data test period to 2008 – 2013. This data period does however encompass the extreme bear market of 2008 resulting from the world financial crisis, and the 2009 – 2013 bull market that followed the market bottom in March 2009.

Importantly for this study, the bull and bear market cycles imbedded in this previous six-year market data period presented a stern test of the robustness and ability of the inter-market technical analysis trading strategies to generate returns in excess of the market and thereby refute the EMH. Additionally, this variety of market environments was beneficial in appraising the applicability of the results to diverse market conditions.

1.7 Delimitations

There is a direct positive correlation between the frequency of intra-day data and the number of trades generated by technical analysis strategies. Due to the need to analyze each individual trade identified by the inter-market strategy from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout, the high frequency intra-day data utilized was limited to 240-minute data in order to generate a manageable number of trades for the purpose of this report.

1.8 Ethics

Data snooping bias refers to the problem that arises when researchers test technical analysis trading rules already proven profitable on part or all of the previously tested dataset (Neely and Weller, 2011). As described by (Ready, 2002), researchers testing popular trading rules might be introducing a form of data snooping bias into their studies, as the popularity of these rules is no doubt the result of their long term effectiveness on that same dataset.

Pukthuanthong-Le and Thomas (2008: 32) advise that “to avoid a data-snooping bias, a trading rule must be chosen before any data tests are run”. The Momentum and Inter-market technical analysis trading rules selected for this study were developed in 1978 and 1997 respectively, more than ten years prior to the 2008 – 2013 data period over which they were evaluated thereby eliminating the risk of introducing data snooping bias into the study.

Researchers that test *ex poste* trading rule strategies additionally introduce the risk of **data mining bias** into the study results, whereby the trading rules are developed and tested on the same body of data (Fyfe, Marney & Tarbert, 1999; Menkhoff and Taylor, 2007).

The *ex ante* nature of this study whereby the technical analysis trading rules were developed on a prior dataset then tested on a much later 2008 – 2013 data period, therefore also eliminated the risk of data mining bias.

1.9 Summary

Despite over half a century of EMH research, there is surprisingly still no consensus and time has only served to harden the resolve of proponents for and against the EMH.

Notwithstanding the opposing research results over the past 50 years, it is generally accepted in academic circles that the developed country capital markets with their advanced infra-structure, depth and liquidity are at a minimum Weak-Form efficient.

Since the Weak-Form EMH proposes that current security prices immediately assimilate all historical information, it therefore also implies that technical analysis (which relies on charts and analysis of past price patterns to extrapolate future price movements) would be a futile exercise. However technical analysis has endured over time and is still an intensively and widely used investment analysis technique.

This indicates a clear disconnect between technical analysis as employed by practitioners in the market and the technical analysis methodologies utilized by academics in prior Weak-Form EMH studies.

The literature review uncovered methodological weaknesses which severely handicap the profit generating potential of technical analysis and suggest that previous Weak-Form EMH research findings were erroneous in being unable to reject the null Weak-Form market efficiency hypothesis.

This study therefore proposes that by eliminating prior methodological weaknesses and utilizing high frequency intra-day data, the combination of qualitative and quantitative techniques, and volume signals to develop inter-market technical analysis strategies, it is possible to generate significant excess profits and consequently show that contrary to prior research findings, the developed country capital markets are not Weak-Form efficient.

1.10 Organization of the Study

Chapter 1 is the orientation which provides an introduction, the research question, the research problem, the research objective, the significance of the study, the limitations and delimitations, ethics and summary.

Chapter 2 is the literature review which describes the background and origin of the EMH, the underlying theory, and the seminal papers that have shaped the EMH debate. The literature review then focuses on the Weak-Form EMH and technical analysis, identifying those technical analysis studies that failed to reject the null Weak-Form market efficiency hypothesis.

Chapter 3 outlines the research question and research problem in more detail.

Chapter 4 describes the methodology and details the Null Hypothesis which supports the Weak-Form EMH: $\boldsymbol{H_0}$ **: α ≤ 0** and the Alternative Hypothesis which implies that the developed country capital markets are not Weak-Form efficient: $\boldsymbol{H_1}$ **: α > 0**

Chapter 5 identifies the data collection and analysis utilized to develop the Intermarket Momentum trading strategies.

Chapter 6 analyzes the results and tests the hypothesis.

Chapter 7 concludes and provides recommendations for future research.

2 LITERATURE REVIEW

2.1 Origin

Simply stated, the EMH proposes that security prices at any point in time fully reflect all available information (Fama, 1970), which from a practical point of view implies that no market participant should be able to consistently generate abnormal returns in excess of the market.

The EMH has its origin in the groundbreaking doctoral thesis *Theorie de la Speculation* of French mathematician Louis Bachelier in 1900. He was the first person to use advanced mathematical techniques to develop a formula that expresses the probability of stock market price movements and the valuation of options (*rentes*) on the Paris Bourse. In his remarkable thesis which was way ahead of its time, Bachelier also developed the mathematics for Brownian Motion five years before Einstein, and his option pricing formula was astonishingly similar to the Nobel prize winning Black-Scholes option pricing model developed seventy-three years later by Fisher Black and Myron Scholes (Davis and Etheridge, 2006).

Bachelier (1900:34) also deduced in his thesis that *"The mathematical expectation of the speculator is zero"* – this laid the foundation upon which the Efficient Market Hypothesis was later built.

Incredibly Bachelier's thesis lay dormant for over half a century until its rediscovery by Yale statistics professor L.J. Savage in 1955. Savage then sent out postcards to his colleagues in economics and finance enquiring of them if they had read the work of Louis Bachelier - one of which landed on the desk of Professor Paul Samuelson at the Massachusetts Institute of Technology (Davis and Etheridge, 2006).

Motivated by Bachelier's work, Samuelson later went on to develop a general stochastic model of price change (Samuelson, 1965) which posits that future price differences are independent of previous period's price differences and will essentially follow a random walk.

This theme was expanded upon by University of Chicago Booth School of Business Professor Eugene Fama in his doctoral thesis (Fama, 1965) where for the first time an "efficient" market is described as a market where there are large numbers of rational, profit-maximizers actively competing such that at any point in time, the actual prices of securities instantaneously fully reflect all known information. Fama then concludes that the random walk hypothesis is built upon the premise of this "efficient" market by proposing that as new information hits the market, actual prices will randomly over-adjust as often as they will under-adjust to this new information, and the time lag in the complete adjustment of actual prices to this new information will also be random as market participants sometimes anticipate the news and other times react following the news. As a result, the successive prices of stocks are independent and essentially follow a random walk.

2.2 Classical EMH Taxonomy

Fama (1970:388) later recognized that the EMH as defined in "security prices at any point in time fully reflect all available information" was too broad in scope to lend itself to rigorous empirical testing. Fama therefore proposed that the EMH be categorized into three information subsets which will allow the determination of the information level at which point the EMH breaks down:

2.2.1 Weak Form EMH

The Weak-Form EMH proposes that security prices at any point in time reflect all past historical information. The weak form EMH therefore implies that technical analysis (which relies on charts of past price patterns to predict future price movements) would be of no value.

2.2.2 Semi-Strong Form EMH

The Semi-Strong Form EMH proposes that security prices at any point in time reflect not only historical information, but all publically available current information. The semi-strong form EMH therefore implies that in addition to technical analysis, fundamental analysis (which relies on an analysis of all publically available past and current information to determine the intrinsic value of a security as a predictor of the future price) would also be of no value.

2.2.3 Strong Form EMH

The Strong Form EMH proposes that security prices at any point in time reflect not only past and current public information, but also monopolistic private insider information. The strong form EMH therefore proposes that access to corporate "inside information" would bear no trading advantage to the holder of such information.

2.3 The Underlying Theory

The main principle behind the EMH is that stock prices at any one time "fully reflect" all available information and thereby optimize resource allocation by providing accurate production-investment signals to firms and investors. This ideal market environment where prices always "fully reflect" all available information is described as being "efficient" (Fama, 1970). In an efficient market, if prices drift away from their intrinsic equilibrium levels, traders immediately pounce on the opportunity and arbitrage forces move prices back to their equilibrium levels.

2.3.1 The "Fair Game" Model

The underlying theory of the EMH is the "Fair Game" model first posited by Bachelier (1900) that the expected return of the speculator is zero, where expected returns can be described notationally as:

$$E(r_{j,t+1} \mid \Phi_t) = \frac{E(P_{j,t+1} \mid \Phi_t) - P_{j,t}}{P_{j,t}} \qquad (2.1)$$

and

$$E(P_{j,t+1} \mid \Phi_t) = [1 + E(r_{j,t+1} \mid \Phi_t)]P_{j,t} \qquad (2.2)$$

where

E is the expected value operator

$P_{j,t}$ is the price of security j at time t

$P_{j,t+1}$ is the price of security j at time $t+1$

$r_{j,t+1}$ is the one − period expected return $(P_{j,t+1} - P_{j,t}) / P_{j,t}$

Φ_t is the information set "fully reflected" in the price at time t

Under the assumption that conditions of market equilibrium can be expressed in terms of expected returns, the "Fair Game" model has an important empirical implication in that it "rules out the possibility of trading systems based only on information in Φ_t earning expected returns in excess of equilibrium expected returns" (Fama, 1970: 385).

If $X_{j,t+1}$ is the excess return of security j at time $t+1$ such that

$$X_{j,t+1} = P_{j,t+1} - E(P_{j,t+1} \mid \Phi_t) \qquad (2.3)$$

where

$P_{j,t+1}$ is the observed price of security j at time $t+1$

$E(P_{j,t+1} \mid \Phi_t)$ is the expected price of security j at time $t+1$ based on the information set Φ_t

Then by definition the "Fair Game" model states that the expected excess return of security j at time $t+1$ based on the information set Φ_t is equal to zero, expressed notationally as

$$E(X_{j,t+1} \mid \Phi_t) = 0 \qquad (2.4)$$

2.3.2 The Martingale Model

The Martingale model is closely related but less restrictive than the "Fair Game" model and states that the stochastic sequence $\{P_{j,t}\}$ for security *j* follows a martingale with respect to the information sequence $\{\Phi_t\}$ if the following property holds (Fama, 1970):

$$\boldsymbol{E(P_{j,t+1} \mid \Phi_t) = P_{j,t}} \qquad (2.5)$$

The Martingale model therefore simply states that the best forecast of the next period's price $P_{j,t+1}$ based on the information set Φ_t, is the current price $P_{j,t}$. This has an important empirical implication for Weak-Form tests of the EMH, since it implies that historical prices have no predictive value and that technical analysis is therefore a worthless exercise.

It follows from (2.5) that by definition then

$$\boldsymbol{E(P_{j,t+1}) - P_{j,t} = 0} \qquad (2.6)$$

which simply means that the Martingale model only holds if $P_{j,t}$ is also a "Fair Game"(LeRoy, 1989).

2.3.3 The Random Walk Model

The Random Walk model hypothesizes that price changes are initiated by new information hitting the market, and since this new information arises in an unpredictable fashion it implies that successive price changes are independent and essentially follow a random walk through time (Fama, 1970).

It follows from the Random Walk model that if successive price changes are independent and random, then both technical and fundamental analysis will be of no predictive value and will not be able to generate excess returns.

The Random Walk model therefore also supports the "Fair Game" model by implying that excess returns will equal zero and that the stock market is consequently a "fair game". This bears an important empirical implication for tests of the Semi-Strong Form EMH.

The Random Walk model can be expressed as:

$$\boldsymbol{f(r_{j,t+1} \mid \Phi_t) = f(r_{j,t+1})} \qquad (2.7)$$

which states that the conditional and marginal probability distributions of an independent random variable are identical (Fama, 1970).

2.4 The Empirical Evidence

The EMH has stimulated voluminous academic research over the last half century. Consequently, the objective here is to focus on the seminal papers that have shaped the EMH debate.

2.4.1 Weak-Form EMH

Empirical studies of the Weak Form EMH rely on statistical tests to determine whether successive security price changes are independent and essentially follow a random walk, from which it is inferred that the market is "efficient". This also implies that security prices have no memory, and therefore historical prices have no bearing on future prices thereby rendering technical analysis to be a worthless exercise. Alternative Weak Form EMH studies therefore test the hypothesis by comparing returns generated by technical analysis trading techniques to a naïve buy-and-hold policy.

Initial studies, Samuelson (1965); and Fama (1965), supported the hypothesis that successive security price changes are independent and follow a random walk. Fama and Blume (1966:240) then showed that the Alexandrian filter rules[3] were unable to outperform a buy-and-hold strategy after taking transaction costs such as brokerage commissions and spreads into account, and therefore confirmed previous statistical serial correlation tests that indicated independence of successive price changes and that "the random walk model is an adequate description of price behavior".

However more powerful computer technology and more frequent historical stock price data intervals allowing more precise statistical inference led to the first cracks in the random walk characteristic of efficient markets. LeRoy (1973) showed that under conditions of investor risk-aversion it can be theoretically proven that the Martingale property fails. His findings were later supported by Lucas (1978) who showed that in a theoretical one-good exchange economy, asset prices need not possess the Martingale property and follow a random sequence.

This anomalous evidence regarding the EMH led a defiant Jensen (1978: 95) to famously declare that "there is no other proposition in economics which has more solid empirical evidence supporting it than the Efficient Market Hypothesis", but he did admit that taken together the scattered pieces of anomalous evidence would challenge future acceptance of the EMH and the methodological procedures used.

Not surprisingly ten years later, using a more advanced volatility based specification test, Lo and MacKinlay (1988) were able to reject the Random Walk Hypothesis for weekly stock returns. Additionally, in a cornerstone technical analysis study, Brock, Lakonishok & LeBaron (1992) found strong support for variants of simple moving average and trading range breakout technical strategies when tested on the Dow Jones Index between 1897 and 1986.

[3] Simple mechanical trading rule developed by Sydney Alexander.

2.4.2 Semi-Strong Form EMH

Empirical studies of the Semi-Strong Form EMH test the hypothesis from two different angles: event studies to determine the speed at which security prices adjust to and reflect current information, or tests to determine whether trading strategies utilizing fundamental analysis consistently generate abnormal returns in excess of the market.

Jensen (1967) developed a risk-adjusted measure of portfolio performance (which aptly is now known as Jensen's Alpha) to analyze the performance of 115 mutual funds (mutual fund managers utilize all publically known information to trade and manage their investment portfolios), and concluded that on average mutual funds were not able to outperform a naïve buy-and-hold policy. Fama, Fisher, Jensen & Roll (1969) performed the first event study to determine the speed at which security prices adjust to the new information of a stock split. They concluded that the stock market is "efficient" in that it adjusts very rapidly to the news of a stock split, in the majority of cases instantaneously after the announcement.

2.4.2.1 Size, Value, Seasonality & Excess Volatility Anomalies

Their evidence however was not supported by later researchers spearheaded by amongst others Basu (1977); French (1980); Grossman and Stiglitz (1980); Shiller (1981); Keim (1983); Keim and Stambaugh (1984); and Ariel (1987) who all found evidence of market capitalization (size), value, seasonality and excess volatility anomalies in stock price time series contrary to the random walk and martingale properties of the EMH.

Basu (1977) discovered a "value" anomaly when he found that portfolios made up of low price-earnings (P/E) ratio stocks (low value stocks) outperformed high P/E ratio stock portfolios (high value stocks), which suggested that P/E ratio information was not fully reflected in stock prices and inefficiencies existed which afforded traders the opportunity to earn abnormal returns.

The first calendar-based seasonal anomaly was unearthed by French (1980) who analyzed the daily returns to the S&P 500 stocks over a 24-year period and found that the mean return to Monday was significantly negative whilst the other four days Tuesday through Friday were positive. He concluded that the negative Monday returns were a result of the "weekend effect" of companies delaying the release of bad news until the weekend to allow the market time to digest the information. The negative Monday returns were therefore an indication of market inefficiency. Subsequent studies (Keim and Stambaugh 1984) confirmed French's "weekend effect" findings even when additional time periods were included in the analysis.

Whilst investigating and confirming the "size effect" of small capitalization stocks outperforming large capitalization stocks, Keim (1983) discovered what has become known as the "January effect" when he found that fifty percent of the size anomaly could be attributed to the month of January. Ariel (1987) then added more impetus to the calendar-based anomalies by uncovering a puzzling "monthly effect" when he showed that mean stock returns were only positive in the first half of calendar months.

A disturbing excess volatility anomaly in stock market prices was uncovered by Shiller (1981) who found that stock market price changes over the past century were statistically five to thirteen times too high to be attributed to subsequent new dividend information. This implies that price changes occur due to unexplained reasons other than subsequent new information, which calls into question the entire underpinnings of the EMH.

2.4.2.2 The "Impossibility" of the EMH

Grossman and Stiglitz (1980) argued that it is impossible for markets to be informationally efficient in the real world where information is costly: if prices fully reflected all available information, informed traders who expended resources to obtain that information would not earn a return and be compensated for their efforts. An unrealistic theoretical world of costless information was therefore a necessary condition for efficient markets but even then the markets would not be in equilibrium as traders would realize that additional profits could be earned by expending resources and becoming more informed. Fama (1991) later agreed with this view and proposed an economically more sensible version of the EMH which stated that prices reflect information to the point where the marginal profits of trading that information do not exceed the marginal costs of acquiring it.

In addition, Oppenheimer and Schlarbaum (1981) found strong contradictory evidence against the EMH by showing that positive abnormal risk-adjusted rates of return were available to investors who followed the value based fundamental analysis stock selection criteria developed by Columbia University professor Benjamin Graham[4].

2.4.2.3 The Behavioral Finance Challenge

More salt was rubbed in the EMH wound created by the contradictory size, value, seasonal and excess volatility evidence with the groundbreaking paper by De Bondt and Thaler (1985). Their findings heralded the beginning of Behavioral Finance, which provides a theoretical challenge to the EMH by questioning the rationality assumption of investors underpinning the EMH and suggesting that cognitive psychology better describes investor behavior. De Bondt and Thaler postulated that traders are human beings with feelings and emotions which result in irrational trading decisions such as the overreaction to market news. This overreaction results in price trends and in extreme cases even market bubbles and crashes. The hypothesis was tested that traders view past winners (stocks that have outperformed the market) as overpriced and past losers (stocks that have underperformed the market) as underpriced, and then basically overreact to this information. Their findings supported the overreaction hypothesis with a portfolio of prior "losers" outperforming the market by 19.6% and a portfolio of prior "winners" underperforming the market by 5% in the 36 months following portfolio formation. In addition, their

[4] One of Benjamin Graham's most famous students is legendary billionaire investor Warren Buffett, who has followed Graham's investment principles his entire career. Buffett's long term trading success raises serious questions regarding the Semi-strong Form EMH and he has been quoted as saying: "I would be a bum on the street with a tin cup if the markets were efficient" to which he later added that "the market is only efficient as a mechanism of transferring wealth from the uninformed investor to the informed investor"

findings supported the seasonal "January effect" with most of the excess returns being realized in the month of January.

Motivated by the work of DeBondt and Thaler on the overreaction effect and its potential impact on contrarian trading strategies, Jegadeesh and Titman (1993) decided to study the impact of over and under reaction to the alternative relative strength strategy of buying past winners and selling past losers. Their findings indicated initial significantly positive returns in the first 12 months, followed by substantially negative returns thereafter in years 2 and 3. This was the first evidence of short-term momentum and long-term mean reversion in stock price time series, a serious blow to the EMH.

2.4.2.4 Support for the EMH

At the time, the lone island in this sea of contradictory size, value, seasonal and behavioral finance evidence was Eun and Shim (1989) who managed to find support for the EMH by using vector autoregressive analysis to show that the relative speed at which international markets reacted to US market shocks proved that international stock markets were informationally efficient.

Shortly thereafter in his second review paper, Fama (1991) attempted to defend the EMH by positing the joint hypothesis problem: tests of the EMH are in fact not only testing market efficiency but also the equilibrium asset pricing model used to statistically analyze the findings. A rejection of the EMH could therefore actually mean a rejection of a misspecified asset pricing model or both. This became known as the "bad model" problem (Fama, 1991). Fama also suggested that the seasonality anomalies may be due to data mining and errors in the Center for Research in Security Prices (CRSP) historical data base utilized in all the seasonality studies. Later in his third review paper, Fama (1998) made the related point that most anomalies were the result of the research methodology used and disappeared with a change in technique. This view was supported by Malkiel (2003) who added that transaction costs would also offset any potential profits that traders could actively glean from the uncovered anomalies. However, Jegadeesh and Titman (2001) argued that their later study using nine additional years of out-of-sample data still showed short term momentum and the persistence of this anomaly.

Fama (1998) also defended the EMH against the Behavioral Finance findings of De Bondt and Thaler (1985) and Jegadeesh and Titman (1993) by positing that overreaction by market participants occurred as frequently as underreaction, and this random split of overreaction versus underreaction was actually consistent with market efficiency.

Atkins and Dyl (1993) also challenged the outperformance due to the overreaction effect postulated by De Bondt and Thaler (1985) on the basis that previous overreaction studies assumed that traders could buy and sell at the database closing prices. Atkins and Dyl argued that in reality traders had to buy at the quoted ask price and sell at the quoted bid price, and posited that the bid-ask spread would have a detrimental effect on earnings of the overreaction strategy of buying past losers and selling past winners. After taking the bid-ask spread into account, Atkins and Dyl (1993: 95) indeed found that the cumulative abnormal returns generated by the overreaction strategy were less than the bid-ask spread, thereby leading them to conclude that contrary to previous overreaction effect studies, no profitable trading

opportunities were present due to the size of the bid-ask spread and "no compelling evidence of market inefficiency is found".

On a similar note, Boldt and Arbit (1984: 31) argued for market efficiency on the basis of the information synthesizing effect of "The Law of Large Numbers" whereby "the error in a consensus declines with the square root of the number of independent opinions reflected in the consensus". In the case of the stock market, this would imply that the individual pricing errors of thousands of traders would at any point in time cancel each other out, such that "the resulting consensus becomes a powerful predictor of future value".

Roll (1994: 71) also noted that after 25 years of market efficiency research as an academic and 10 years as a practicing money manager, even empirically robust size, value and seasonality anomalies were extremely difficult to exploit in a real world trading environment, lamenting that he has "never yet found one that worked in practice, in the sense that it returned more after cost than a buy-and-hold strategy."

Subsequent studies by Metcalf and Malkiel (1994); Malkiel (1995); and Chan*, et al*. (1997) lent some much needed further support to the EMH. The results of a Wall Street Journal newspaper contest that pitted a portfolio of stocks selected by experts against a portfolio of stocks randomly selected by throwing darts created a lot of publicity at the time. Metcalf and Malkiel (1994) analyzed the results and found that although the "expert" portfolio beat the "dart" portfolio and the market, statistical tests showed that the additional return earned by the "expert" portfolio could be wholly attributed to the riskier stocks selected by the experts and the publicity effect of the contest which stimulated public buying of the expert selected stocks. Metcalf and Malkiel (1994:374) therefore concluded that the statistical tests "provide strong support" for the EMH and (tongue in cheek) "stock picking by darts continues to be a respectable investment tool."

Malkiel (1995) studied Equity Mutual Fund returns in the period 1971 to 1991 using the updated Lipper database which accounted for survivorship bias and his findings supported the earlier work of Jensen (1968): mutual funds underperform the market even gross of management fees, and more importantly, there is no evidence of performance persistence with little correlation between funds that outperform in one year and funds that outperform in the next, thereby strengthening the belief that "securities markets are remarkably efficient" (Malkiel 1995: 571).

The earlier work of Eun and Shim (1989) regarding international market efficiency was confirmed by Chan, *et al*. (1997), who tested eighteen major international stock markets using a unit root test and found that individually, they all followed a random walk and were thus weak-form efficient. However, in a more stringent trading rules study of 24 international stock market indexes utilizing momentum, oscillation and relative strength indicators, Chu (2003) found only the 10 most developed countries to be weak-form efficient. Not surprisingly Chu was able to show significantly positive excess profits in the underdeveloped financial markets of the emerging market countries and concluded that they were still inefficient.

2.4.2.5 Bubbles and the EMH

The internet dot com bubble that developed in the late 1990's and then burst in the year 2000 presented another challenge to the EMH as it was difficult to reconcile the unrealistic valuations afforded to internet stocks with the workings of a rational efficient market. Behavioralists asserted that the bubble was due to irrational exuberance, the herding effect of market participants and the feedback effects fueled by word-of-mouth and the media (Shiller 2003).

However, Blanchard and Watson (1982) proposed that there may well be rational deviations of asset prices from their fundamental values resulting in the formation of rational bubbles, under conditions where market participants believe there are extraneous events influencing the asset price in addition to the fundamentals. Malkiel (2003) later supported this viewpoint when he argued that one can only recognize a bubble in hindsight and that at the time market participants were behaving rationally in assigning high valuations to dot com stocks as they believed that the internet was heralding the beginning of a "new economy" and a paradigm shift in the way business would be conducted.

Shortly thereafter, the housing and credit bubble which ultimately resulted in the global financial crash of 2008 presented another blow to the EMH with critics blaming the EMH for the crisis under the premise that blind faith in efficient markets led to reduced government regulation of the financial markets (Ball, 2009; and Brown, 2011). This factor facilitated the creation of high risk sub-prime mortgage CDO's to which banks worldwide had trillions of dollars' exposure, and which ultimately led to the housing and credit bubble.

Ball however defended the EMH by arguing that bubbles have always existed, many of them occurring before the EMH was even posited by Fama in 1965. Malkiel (2011: 51) also continued to defend the EMH by arguing that none of the anomalous evidence against the EMH offered *ex ante* consistently profitable arbitrage opportunities, and therefore concluded that the "financial markets are remarkably efficient, and that EMH remains a most useful hypothesis approximating how our financial markets actually work".

Brown (2011:95) even went on to suggest that financial institutions, comforted in the belief that the EMH had no real practical implications, borrowed heavily to invest in CDO's and since this leverage was a leading factor in the 2008 global financial crisis, "one might take the view that it was the failure to believe the EMH that was in fact responsible for the crisis".

2.4.3 Strong-Form EMH

There is little evidence to support the Strong Form EMH as insider trading is illegal and strictly enforced by the legal system in most countries. Consequently, there is thus a lack of reliable data on insider trading thereby rendering it impractical to empirically test the Strong Form EMH and it is generally accepted in academic circles that the Strong Form EMH is not "an exact description of reality" (Fama, 1970: 409).

The recent 11-year sentence of high profile billionaire, Galleon hedge fund founder Raj Rajaratnam (USA Today, 2011) in New York for illegal insider trading bears testimony to the low tolerance of the courts for

perpetrators of insider trading and hints at the obvious (illegal) advantages to be gleaned by trading on insider information, all of which flies in the face of the Strong Form EMH.

In addition, a recent television news report (CBS *60 Minutes, 2011*) alleges that Washington Congressmen, due to their immunity from Securities and Exchange Commission (SEC) Insider Trading laws, have been not only abusing their access to corporate lobbyists in Washington to obtain insider information but also their non-public knowledge of pending corporate legislation to engage in stock trades for their personal accounts that have earned them abnormal returns on average 12% in excess of the market. This would naturally be convincing evidence against the Strong Form EMH.

It can be argued however that the performance of hedge funds & mutual funds, with their resources and contacts within the upper echelons of corporate management, can be viewed as a proxy for "insider trading" and that their underperformance as a group (Jensen, 1967; Malkiel, 1995; and Morningstar, 2011) strengthens the case for even the strong form EMH.

2.5 EMH Synopsis

The EMH reached the height of its dominance in academic circles around the 1970s. Beginning in the 1980's however, faith in the EMH was eroded by the discovery of a succession of anomalies regarding capitalization, value, seasonality, behavioral and excess volatility inconsistencies. Thereafter the evidence has been mixed-and time has only served to harden the resolve of proponents for and against the EMH. Ironically, in order to hold the EMH relies on the daily trading actions of market participants who inherently believe that pricing anomalies do exist and that the markets are not efficient.

Additionally, the hypothesis does have a glaring weakness in the context of its formulation as it is based on the assumption that all market participants are rational, profit-maximizing agents that trade on information only, but in reality they are simply human beings with emotions of fear and greed that sometimes behave irrationally and get caught up in the hysteria of crowds (Nichols, 1993). To complicate matters even further, market participants are characterized by diverse backgrounds, languages and cultures and therefore they interpret information differently (Gouws, 2003).

Having said that however, there does seem to be consensus in the fact that the collective wisdom of the market will eventually prevail and drive prices to their intrinsic equilibrium levels, but the question remains as to whether the anomalies observed *en route* afford market participants the opportunity to earn excess profits.

2.6 Weak-Form EMH Focus

Notwithstanding the opposing research results over the past 50 years, it is generally accepted in academic circles (Brown, 2011; Ball, 2009; Malkiel 2005 & 2011) that the developed country capital markets with their advanced infra-structure, depth and liquidity are at a minimum Weak-Form efficient. In their review paper, Park and Irwin (2007) confirmed this viewpoint by concluding that technical trading rules only

yielded economic profits in the US stock markets until the late 1980's, and in the foreign exchange markets only until the early 1990's. Their conclusion is supported by more recent research findings (Pukthuanthong-Le and Thomas, 2008; and Neely, Weller & Ulrich, 2009) that show the significant erosion of trading rule profits as of the mid-1990s.

In terms of the Weak-Form EMH as proposed by Fama (1970), security prices at any point in time reflect all past historical information and as a consequence therefore the best estimate of a future price is the current price.

The majority of Weak-Form EMH research studies (Samuelson, 1965; Fama, 1965; and Mabhunu, 2004) primarily focused on statistical serial correlation and runs tests aimed at proving that a stock market time series follows a statistically random walk from which it is inferred that the market is Weak-Form efficient. However, as posited by Brown (2011:87) a random walk alone is not a "necessary nor sufficient condition to establish a violation of the EMH." He concludes that it is necessary to "show the profitability of a trading strategy based on information available at the time the trades are made." In addition, as noted by Fama (1965), the complicated technical chart patterns utilized in technical analysis to predict future prices are geometric in nature and not captured in a simple linear statistical random walk test.

2.7 Technical Analysis

Since the Weak-Form EMH proposes that current security prices immediately assimilate all historical information, it therefore also implies that technical analysis (which relies on charts and analysis of past price patterns to extrapolate future price movements) would be a futile exercise.

As an alternative Weak-Form EMH test, technical analysis is therefore challenged to generate significant excess returns in order to invalidate the hypothesis. This form of test also follows Brown (2011) and Malkiel (2003), who both propose that the real acid test of market efficiency is one that measures the ability of traders to consistently generate excess returns.

2.7.1 Background

Technical analysis can trace its roots back to mid-18th century Japan where Munehisa Homma, a rice merchant, pioneered the use of candlestick charts – an analysis technique still popular among technical analysts today (Silber, 2010).

Later at the turn of the 20th century, Charles Dow (co-founder of the benchmark Dow Jones Index) formulated a technical analysis approach to stock market movements still widely followed on Wall Street and known today as the Dow Theory. Simply stated according to Dow, a movement in the Industrial average can only be confirmed if it is accompanied, and preceded, by a movement in the Transport average. If this movement coincides with high volume, it is a signal that a trend is developing and should persist until such time that the two averages diverge - a warning signal of a trend reversal (Silber, 2010).

Over the past 100 years, computer technology advancements stimulated the evolvement of technical analysis with the development of complex charts and indicators leading to the founding of the Market Technicians Association (MTA) in New York in 1973 and the professional Chartered Market Technician (CMT) designation in 1985 (Silber, 2010).

Although often derided by academics since it flies in the face of the EMH even in its weakest form, technical analysis has endured over time and is still an intensively and widely used investment analysis technique by practitioners known as technical analysts or chartists (Menkhoff and Taylor, 2007). In an extensive survey of 200 foreign exchange and international fund managers, Gehrig and Menkhoff (2006) found that technical analysts make up the largest group among foreign exchange traders and the second largest group among international fund managers.

2.7.2 Principles

Technical analysis is based on three guiding principles (Neely, 1997):

The price history incorporates all relevant information about the asset, thereby rendering fundamental economic analysis superfluous.

Prices move in trends – "trade with the trend" or "the trend is your friend" are common technical analysis maxims.

History repeats itself – traders tend to react the same way when confronted with the same conditions.

2.8 Methods

Technical analysis can be performed in a qualitative manner, where charts of historical price patterns are utilized to predict future price movements, or it can be strictly quantitative, where price forecasts are made by mechanical trading rules or indicators constructed through a mathematical analysis of historical prices. In practice, technical analysts will often employ a combination of qualitative and quantitative methods (Menkhoff and Taylor, 2007).

Notwithstanding the plethora of complex and exotic indicators that have developed alongside advancements in computer technology, a branch of technical analysis that has gained in importance is that of intermarket analysis, where the technical analysis of one markets price history is used to take positions in another related market (Neely, 1997).

2.8.1 Qualitative Charting

Charting involves the subjective identification of patterns in historical price data which are then used to project future price movements. In order to be effective, charting relies on the repetition of easily identifiable patterns and the principle that traders tend to react in the same way when confronted with the same conditions. Charting therefore takes advantage of market psychology and the predictable

behavior of traders with the result that the chart pattern then becomes a self-fulfilling prophesy (Menkhoff and Taylor, 2007).

An alternative charting technique utilizes prior price peaks and troughs to draw trendlines of support and resistance. The validity of the trendline is determined by the price touching, but not violating, the trendline on three or more occasions. If the price does penetrate and close outside of a confirmed support or resistance trendline, this is a signal of a tradable price breakout (Neely, 1997).

Subjective qualitative chart patterns are non-linear and therefore difficult to quantify and formulate mathematically, therefore not surprisingly a literature review has revealed a paucity of rigorous research aimed at determining the effectiveness of qualitative charting and its resultant potential to generate significant profits and thereby invalidate the Weak-Form EMH.

The first empirical study of chart patterns was undertaken by Levy (1971), who tested the predictive significance of thirty-two possible forms of five-point chart patterns (*i.e.* patterns with two highs and three lows, or two lows and three highs). The thirty-two patterns identified were variations of popular chart patterns, namely channels, wedges, triangles, head and shoulders, inverse head and shoulders, triple tops and triple bottoms. Each of these historical price patterns has implications for future price behavior as they enable the chartist to predict future price movement subsequent to the formation of the pattern.

Using simplifying assumptions for pattern specification and recognition, Levy (1971: 318) tested the patterns on the daily closing prices of 548 NYSE stocks over a five-year period from 1964 – 1969 and found that "after taking trading costs into account, none of the thirty-two patterns showed any evidence of profitable forecasting ability in either (bullish or bearish) direction".

In a later study, Osler and Chang (1995) focused solely on the predictive power of the head and shoulders pattern, since it was cited by practitioners as being the most reliable of all chart patterns. The primary features of the head and shoulders pattern consist of three consecutive peaks with the highest (the head) in the middle. The left and right peaks are known as "shoulders" and the straight line connecting the troughs separating the head from the left and right shoulders is known as the "neckline". Price penetrating the neckline of a head and shoulders pattern offers the chartist a trade entry position as it signals a trend reversal with the price continuing to move in the direction of the new trend.

Utilizing more advanced computer technology to overcome the simplifying assumptions inherent in the earlier Levy study, Osler and Chang were able to specify detailed parameters in a pattern identification computer based algorithm that captured the head and shoulders pattern features as specified in published technical analysis manuals. In addition, contrary to Levy and more in line with accepted practice, they were able to program an explicit trade entry based on price penetrating and closing outside of the neckline, and test a number of endogenous and exogenous trade exits.

The head and shoulders trading rule algorithm was then tested on twenty years of daily exchange rate data for six major currencies between 1973 and 1994 and the results were inconclusive. After adjusting for transaction costs, interest rate differentials and risk, the head and shoulders pattern appeared to have predictive power for only two out of the six currencies leading Osler and Chang (1995: 38) to conclude

that “much more research is needed before there will be any consensus regarding the predictive value of visual chart patterns in general, or the head and shoulders pattern, in particular”.

Following Osler and Chang, a pattern recognition algorithm was also utilized by Omrane and Van Oppens (2008) to detect twelve patterns in six months of Euro/Dollar exchange rate data. Omrane and Van Oppens improved on prior studies by using high frequency intra-day five-minute data and building high and low prices, in addition to closing prices, into their algorithm. A Monte Carlo simulation was run to compute the statistical significance of the results which supported the earlier findings of Levy and Osler and Chang. Only two patterns out of the sample of twelve exhibited significant profitability which was however too small to cover the transaction costs and Omrane and Van Oppens therefore concluded that although chart patterns seem to exist in the Euro/Dollar exchange rate data, trading rules related to them seem unprofitable.

2.8.2 Quantitative Mechanical Rules & Indicators

Mechanical rules and indicators utilize the objective mathematical analysis of historical prices to provide explicit buy or sell signals, thereby removing the subjectivity of the trader and the emotions of fear and greed that could potentially be detrimental to the trading strategy.

Mechanical rules either exploit definite trends in the price data, known as “trend following” or “momentum” indicators; or instances where the market is consolidating and moving sideways in a range, known as “oscillators” or “range trading” indicators.

Trend following indicators are based on the principle that prices move in trends, and attempt to profit from the premise that once prices breakout from a trading range they will trend and continue to move in that direction.

Range trading indicators are effective in a non-trending sideways moving market where the price oscillates around a median level, by indicating overbought and oversold levels which are signals that the price has deviated too far from the median and that a price reversal back to the median level is imminent (Menkhoff and Taylor, 2007).

Quantitative mechanical rules lend themselves to effective mathematical formulation, consequently there have been numerous academic mechanical rule tests of the Weak-Form EMH utilizing one or more of the most popular technical indicators. The focus here will be on those studies that failed to reject the Weak-Form EMH null hypothesis.

2.8.2.1 Trend Following: Filter Rule

The first known technical analysis test of the EMH in the literature was performed by Alexander (1961), who developed a filter rule with the purpose of masking short term price fluctuations in an attempt to identify long term price trends. Thereafter known as the Alexandrian Filter Rule, it clearly dictates long and short positions in the market by means of a price movement percentage filter, such that if the market

moves up *x* %, initiate a long position and stay long until the market moves down *x* %, at which point sell and go short and stay short until the market moves up *x* % again, whilst ignoring price moves less than x%.

The filter rule can be expressed mathematically as (Menkhoff and Taylor, 2007):

Buy: $$100\frac{(S_t - \{S_{t-i} \mid i=\min[i>0 \mid (S_{t-i} - S_t) < 0 \;\&\; (S_{t-i} - S_{t-1-i}) < 0]\})}{\{S_{t-i} \mid i=\min[i>0 \mid (S_{t-i} - S_t) < 0 \;\&\; (S_{t-i} - S_{t-1-i}) < 0]\}} > x\%,$$ ***and***

Sell: $$100\frac{(\{S_{t-i} \mid i=\min[i>0 \mid (S_{t-i} - S_t) > 0 \;\&\; (S_{t-i} - S_{t-1-i}) > 0]\} - S_t)}{\{S_{t-i} \mid i=\min[i>0 \mid (S_{t-i} - S_t) > 0 \;\&\; (S_{t-i} - S_{t-1-i}) > 0]\}} > x\%$$

Alexander (1961) tested filter sizes between 5 and 50% on the S&P Index between 1897 and 1959, and found that the smaller filters yielded (before commissions) higher returns than buy-and-hold. However, Alexander (1961: 23) admitted that "from a practical standpoint these profits would be substantially reduced, but by no means eliminated, by the payment of commissions" and challenged the reader to compute an allowance for commissions, thereby rendering his results inconclusive.

Fama and Blume (1966) took up Alexander's challenge and re-calculated the Alexandrian Filter Rules taking clearinghouse fees and broker commissions into account, and found that these trading costs substantially reduced the returns of the filters thereby erasing the advantage of the filters over buy and hold. The failure of the filters to outperform buy-and-hold led Fama and Blume (1966: 240) to conclude that "for practical purposes the random-walk model is an adequate description of price behavior".

Lee and Sodoikhuu (2012) tested the Alexandrian filter rules on 7 years of foreign exchange data for the Euro (EUR), Japanese Yen (JPY) and British Pound (GBP) between 2003 and 2009, and found that the foreign exchange market is efficient thereby confirming the earlier findings of Fama and Blume.

Van Landingham (1980) tested three simple buy-sell filters on the NYSE during a relatively short sample period of 1972 – 1975, utilizing the 20 day moving average of a standard array of predictive indicators including new highs for the year, new lows for the year, the number of advancing / declining stocks, and the total volume of odd-lot purchases / short sales. Despite the simplifying assumptions of no dividends and taxes, and no differential risk between the trader and the buy-and hold portfolios, Van Landingham (1980: 353) found that "no combination of technical indicators and filter rules seemed capable of consistently beating the market", thereby also supporting the efficient market finding of Fama and Blume.

2.8.2.2 Trend Following: Moving Average (MA) Crossover

A short run moving average crossing over a long run moving average from below (above) provides a buy (sell) signal as it indicates that price is breaking out of a trading range and initiating a trend in the direction of the breakout. The Moving Average crossover can be expressed as (Menkhoff and Taylor, 2007):

Buy Signal: $MA_{t-1}(m) < MA_{t-1}(n)$ and $MA_t(m) > MA_t(n)$, $m < n$

Sell Signal: $MA_{t-1}(m) > MA_{t-1}(n)$ and $MA_t(m) < MA_t(n)$, $m < n$

where

MA is the moving average, and

$$MA_t(j) \frac{1}{j} \sum_{i=0}^{j-1} P_{t-i}, \quad j = m,n$$

The Moving Average (MA) crossover was used by Dempsey, Hudson & Keasey (1996) to test the Weak-Form efficiency of the United Kingdom (U.K.) stock market by applying the same simple technical trading rules as Brock, *et al.,* (1992) to the daily series of the Financial Times Industrial Ordinary Index (FT) from 1935 – 1994. The objective of the study was to determine whether the strong positive results found by Brock, *et al*. supporting technical analysis on the Dow Jones Index between 1897 and 1986 were replicable on U.K. data.

The Brock, *et al.* technical trading rules tested were the Variable Moving Average (VMA), whereby buy (sell) signals are initiated when the short run moving average is above (below) the long run moving average; the Fixed Moving Average (FMA), whereby buy (sell) signals are initiated when the short run moving average crosses the long run moving average from below (above); and the Trading Range Breakout (TRB) which is essentially a filter rule, whereby buy (sell) signals are generated by the price level penetrating above (below) the predefined previous period high (low).

Although variants of the trading rules showed significant predictive ability when applied to the U.K. data, Dempsey, *et al*. (1996: 1131) found that the Brock, *et al.* trading rules would not be able to generate excess returns in the presence of trading commissions and the bid-ask spread, concluding that contrary to the positive results found by Brock, *et al.* on the Dow Jones Index, in terms of the U.K. stock market "the present results are seen as supporting the weak form efficiency of financial markets".

The findings of Dempsey, *et al*. were later confirmed in the Taiwan stock market by Chen, Huang & Lai (2011) by testing the Brock, *et al.* moving average and filter rules on daily data between 1971 and 2006.

In an improvement on the robustness of earlier study results, Chen, *et al*. also applied two powerful bootstrapping tests, White's Reality Check and Hansen's Superior Performance Ability, to adjust for data snooping bias, and a one-day lag adjustment was introduced to accommodate for non-synchronous trading bias. Finally, transaction costs were taken into account and this triad of bootstrapping, non-synchronous trading and transaction costs significantly reduced trading rule profits to the extent that Chen, *et al*., (2011: 210) were able to conclude that "the Taiwan stock market in fact stands for market

efficiency and results show that economical profits cannot be rendered from technical analysis in this market".

2.8.2.3 Trend Following: Momentum Indicator (MOM)

The Momentum (MOM) indicator is defined simply as the difference between the closing prices of two trading days, thus the *N* day Momentum is calculated by subtracting the closing price at t - *N* from the closing price at time *t* (Chong, Cheung & Wong, 2010):

$$MOM_{N(t)} = P_t - P_{t-N}$$

The MOM trading rules are defined as follows:

Buy: ***MOM(t-1) < 0 and MOM(t) > 0***

Sell: ***MOM(t-1) > 0 and MOM(t) < 0***

Thus, a buy (sell) signal is triggered when the MOM crosses the zero line from below (above).

Pukthuanthong-Le and Thomas (2008) tested simple trend following Momentum (MOM) and Moving Average (MA) crossover trading rules on currency futures of the major liquid currency pairs over the 1975 – 2006 period. The use of currency futures over spot currency rates in their study eliminates the need for overnight interest rates and spot interbank deposits, as currency futures reflect the contemporaneous interest differential between the foreign currency and the base currency.

Their results showed that profitability to trend following trading rules in the major currency markets steadily declined over time and then vanished in the post 2000 period. Pukthuanthong-Le and Thomas (2008: 37) posited that this erosion in profits was due to arbitrage forces as traders learnt and adapted their strategies and led them to conclude that "the currency markets became weak-form efficient sometime during the late 1990s and have remained so since 2000".

This result was later confirmed by Neely, Weller & Ulrich (2009: 486), who tested the moving average and filter rules of earlier studies *ex poste* on later out-of-sample data and found that "by the mid-1990s, profit opportunities had largely disappeared for these popular classes of rules".

2.8.2.4 Range Trading: Relative Strength Indicator (RSI)

In a non-trending sideways moving market, the Relative Strength Indicator (RSI) oscillator is effective in indicating overbought / oversold conditions and imminent price reversals. The RSI measures the strength of "up" movements relative to the strength of "down" movements for the most recent period of *n* days, using the following formula (Coe and Laosethakul, 2010):

$$RSI_t = \left[\frac{U_t^{n-1}}{D_t^{n-1} + U_t^{n-1}}\right] \text{ x 100} \qquad \textit{where}$$

U_t is the average of the closing prices for those days where the price increases from the previous day

D_t is the average of the closing prices for those days where the price declines from the previous day

t ranges from 0 - *n-1*

The RSI is normalized to lie between 0 and 100, where an RSI > 70 indicates an overbought condition thereby signaling an imminent downward price correction, and an RSI < 30 is indicative of an oversold condition and signals an imminent upward price correction.

2.8.2.5 Range Trading: Stochastic Oscillator (K)

Similar to the RSI, the Stochastic Oscillator indicates overbought and oversold conditions in a non-trending sideways moving market. The Stochastic Oscillator (*K*) compares the value of current closing prices with the intra-day price range over an *n* day trading period, and can be expressed as (Coe and Laosethakul, 2010):

$$K_t = \left[\frac{P_t - L_t^{n-1}}{H_t^{n-1} - L_t^{n-1}}\right] \text{ x 100} \qquad \textit{where}$$

P_t is the current closing price

H_t is the highest high, and

L_t is the lowest low

As in the case of the RSI, a Stochastic Oscillator value > 70 indicates an overbought condition and a value < 30 that of an oversold condition.

Jensen and Benington (1970) tested a "relative strength" trading rule based on the ratio of a stock price to its 27-week average, whereby equal dollar amounts would be invested in X % of the securities in the sample with the highest ratios and going forward, those securities in the sample with the lowest ratios below a hurdle rank K would be sold and the proceeds immediately invested in the X% of securities with the highest ratios.

The relative strength rule was tested extensively over seven non-overlapping five year periods on between three to five randomly selected samples of 200 NYSE securities within each time period. Net of transaction costs, they find that the trading rules on average earned returns that were equivalent to or less than the buy-and-hold policy.

However, after accounting for the higher risk inherent in the trading rule portfolios utilizing the CAPM, Jensen and Benington (1970: 481) found that the "relative strength" trading rules net of transaction costs earned on average considerably less than the equivalent risk buy-and-hold policy, leading them to

conclude that "the behavior of security prices on the NYSE is remarkably close to that predicted by the efficient market theories of security price behavior".

A later Relative Strength Indicator (RSI) test was conducted by Chu (2003), who used the daily closing prices on 24 country indexes and the Morgan Stanley Capital International (MSCI) world index during the five-year period 1989 – 2004 to test Relative Strength, Momentum and Oscillation strategies.

Chu (2003: 27) also found the ten developed country indexes to be weak-form efficient as "there are inadequate evidences to prove the existence of excessive profits beyond the buy-and-hold strategy".

These results were confirmed by Coe and Laosethakul (2010) who even combined the RSI with three other technical indicators. Trading rules generated by the RSI, Stochastic Oscillator, a moving average of the Stochastic Oscillator and an arithmetic Moving Average were tested by Coe and Laosethakul on 576 stocks that comprise the S&P 100, the NASDAQ 100 and the S&P Midcap 400 in an investigation of the Weak-Form efficiency of the US stock market.

The trading rules were tested on the daily high, low, and closing price data over a 9 ½ year period between January 2000 and June 2009 and the results compared against a naïve buy-and-hold strategy. Despite not taking the profit eroding effects of transaction costs into consideration, Coe and Laosethakul still found that on average the trading rules resulted in a disappointing loss of $2.40 per share compared to a $4.47 average gain per share using a passive buy-and-hold strategy, concluding that "since technical trading rules cannot be used to consistently beat a long-term buy and hold strategy, we recommend that investors first use fundamental analysis to select stocks and then apply a technical trading rule to enhance potential trading gains".

2.8.2.6 Trend Following: Moving Average Convergence Divergence (MACD)

The Moving Average Convergence Divergence (MACD) is a popular trend following indicator and can be expressed as the difference between the 26 day exponential moving average (EMA) and the 12 day EMA, where the MACD signal line is the 9 day EMA of the MACD, such that (Chong, Cheung & Wong, 2010):

$$MACD_{(t)} = EMA_{M(t)} - EMA_{N(t)} \qquad \textit{where}$$

M = 26 days

N = *12 days, and*

EMA is the *N* day exponential moving average defined as:

$$EMA_{N(t)} = aP_{(t)} + (1 - a)EMA_{N(t-1)}$$

$$EMA_N(1) = P(1)$$

$$a = {}^{2}/_{N}$$

The MACD trading rules are defined as follows:

Buy: ***MACD(t-1) < signal line(t-1) and MACD(t) > signal line(t)***

Sell: ***MACD(t-1) > signal line(t-1) and MACD(t) < signal line(t)***

Thus, a buy (sell) signal is generated when the MACD crosses its signal line from below (above).

The MACD was utilized by Sehgal and Gupta (2007) who investigated the economic feasibility of technical analysis in the Indian stock market by applying nine trend following and price oscillator technical indicators (including the MACD, MA and RSI) to seventy-five large companies listed on the BSE-100 Index.

Utilizing 6 years of daily price data and sorting for industry and fundamental size and value factors, Sehgal and Gupta (2007: 11) nevertheless found that none of the indicators outperformed simple buy-and-hold after accounting for transaction costs and slippage, leading them to conclude that "our results seem to confirm with the efficient market hypothesis". This was a surprising result, as India is still classified as an emerging market economy.

In a more expansive emerging market study, Chong, Cheung & Wong (2010) investigated the stock market efficiency of the BRIC (Brazil, Russia, India & China) emerging market countries by utilizing four popular technical indicators, namely the Moving Average Convergence Divergence (MACD), Simple Moving Average (SMA), the Relative Strength Indicator (RSI) and the Momentum Indicator (MOM).

The annualized rate of return generated by trading rules associated with these indicators was calculated on the daily closing prices of the BRIC indexes between 1995 and 2008 and compared to the buy-and-hold return. Chong, *et al*. confirmed the earlier result of Sehgal and Gupta regarding the efficiency of the BSE 100 Index, as the oldest stock markets (Brazil and India) were shown to be relatively efficient, while the markets of Russia and China were inefficient with many trading rules generating excess returns.

This result supports the thesis that market efficiency improves with maturity, however it should be noted that Chong, *et al*. did not adjust the trading rule returns for risk or transaction costs. These two issues could conceivably erode away the excess returns and render inconclusive the inefficient result found in the Russian and Chinese stock markets.

2.8.2.7 Trend Following: The Parabolic Stop and Reverse (SAR)

The Parabolic SAR is a trend following indicator that plots below the price in an up trend, and above the price in a down trend. A switch in the SAR plot from above to below the price (or *vice versa)* is a signal of a change in the direction of the trend, hence the name "stop and reverse". The Parabolic SAR can be calculated by (Chen and Metghalchi, 2012):

$$SAR_{t+1} = SAR_t + AF*(EP_t - SAR_t) \quad \textit{where}$$

SAR_t and SAR_{t+1} represent the current period and the next period's SAR values, respectively
EP_t is the Extreme Point, representing the highest (lowest) price reached during the current up (down) trend
AF is the Acceleration Factor, increased by 0.02 each time a new *EP* is recorded and capped at 0.2

Price trending above (below) the Parabolic SAR indicates a buy (sell) signal.

Chen and Metghalchi (2012) employed the Parabolic Stop and Reverse (SAR) in addition to the Moving Average (MA), Moving Average Convergence Divergence (MACD), Directional Movement Index (DMI), Relative Strength Indicator (RSI) and Stochastic Oscillator (K) indicators to test the Weak-Form efficiency of the Brazilian stock index (BOVESPA) over a 15-year period between 1996 and 2011.

The buy-sell differences of all 32 trading rules generated by single, double or triple indicator combinations failed to beat the buy and hold strategy and resulted in insignificant *t*-tests. Chen and Metghalchi were therefore able to confirm the earlier finding of Chong *et al*. and strongly support the Weak-Form EMH in the Brazilian stock market (BOVESPA).

2.8.2.8 Trend Following: The Directional Movement Index (DMI) & Average Directional Movement Index (ADX)

The +DMI and the –DMI represent upward and downward price movements as a fraction of the trading range over a period of N-days (Lam and Chong, 2006):

$$+DMI_{N(t)} = \frac{\sum_{i=t-N+1}^{t} +DM_i}{\sum_{i=t-N+1}^{t} TR_i}$$

and

$$-DMI_{N(t)} = \frac{\sum_{i=t-N+1}^{t} -DM_i}{\sum_{i=t-N+1}^{t} TR_i}$$

where

TR is the Trading Range defined as TR_t = max$\{P(High)_t - P(Low)_t, P(High)_t - P_{t-1}, P_{t-1} - P(Low)_t\}$

and

$$+DM_t = \begin{cases} PH_t - PH_{t-1} \begin{cases} PH_t - PH_{t-1} > 0 \textit{ and} \\ PH_t - PH_{t-1} > PL_{t-1} - PL_t \end{cases} \\ 0 \quad \textit{otherwise} \end{cases}$$

$$-DM_t = \begin{cases} PL_{t-1} - PL_t \begin{cases} PL_{t-1} - PL_t > 0 \textit{ and} \\ PL_{t-1} - PL_t > PH_t - PH_{t-1} \end{cases} \\ 0 \quad \textit{otherwise} \end{cases}$$

The *N* day ADX at time t is defined as an N-day simple moving average of the N-day DX (Lam and Chong, 2006):

$$\boldsymbol{ADX_{N(t)} = \frac{\sum_{i=t-N+1}^{t} DX_{N(i)}}{N}}$$

where

$$\boldsymbol{DX_{N(t)} = \left|\frac{(+DMI_{N(t)})-(-DMI_{N(t)})}{(+DMI_{N(t)})+(-DMI_{N(t)})}\right| \text{ x } 100}$$

The ADX measures the strength of the trend and ranges from 0 to 100, where an ADX ≥ 20 is considered to indicate a strong trend.

The DMI is used in conjunction with the ADX to generate the following trading rules: a buy signal is triggered if the +DMI crosses over the –DMI, and a sell signal is triggered if the –DMI crosses over the +DMI, with the ADX ≥ 20 indicating a strong trend and acting as a conditional filter (Lam and Chong, 2006):

Buy: $\boldsymbol{+DMI_{N(t-1)} < -DMI_{N(t-1)}}$ ***and*** $\boldsymbol{+DMI_{N(t)} > -DMI_{N(t)}}$

Sell: $\boldsymbol{-DMI_{N(t-1)} < +DMI_{N(t-1)}}$ ***and*** $\boldsymbol{-DMI_{N(t)} > +DMI_{N(t)}}$

and **ADX ≥ 20**

The Directional Movement Index (DMI) in combination with the Average Directional Movement Index (ADX) was applied by Lam and Chong (2006) to the Hang Seng, KOSPI, Nikkei 225, TWSE, UK and US stock markets over a 15-year period ending in 2003 utilizing intra-day high, intra-day low and daily closing prices.

The methodology used the trading rule whereby the +DMI crossing over the –DMI indicated a buy signal, and the –DMI crossing over the +DMI indicated a sell signal, with the ADX ≥ 20 indicating a strong trend and acting as a conditional filter. Without accounting for transaction costs and the bid-ask spread, Lam and Chong still found the DMI trading rules underperformed buy-and-hold in the US and UK stock markets.

2.8.2.9 Market Timing: P/E and Dividend Yield Ratios

Fisher and Statman (2006) performed a study where historical median price per share / earnings per share (P/E) and dividend per share / price per share (Dividend Yield) ratios were utilized as market timing trading rules.

The methodology signaled a switch from stocks into treasury bills when the stock market P/E ratio exceeded its historical average and the dividend yield dropped below its historical average (both indicate that the market is overvalued), and a switch back into stocks from treasury bills when the P/E ratio fell below its historical average and the dividend yield rose above its long term average (an indication that the market is undervalued).

Fisher and Statman tested a range of critical P/E and dividend yield ratios on the US, UK, German and Japanese markets between 1970 and 2002 and found that in general, market timers using the preceding period mean P/E and dividend yield ratios would have accumulated far less than a simple buy-and-hold investor, thereby confirming market efficiency.

2.8.2.10 Genetic Programming

In order to overcome the potential problem of data snooping bias and the small number of mechanical rule variants tested by prior researchers, Fyfe, Marney & Tarbert (1999) utilized a genetic programming approach to generate the fittest mechanical rule that would maximize profits subject to a 1% transaction cost.

The data tested was a seventeen-year closing price series of a property investment company in the UK market, and the only successful rule that generated returns in excess of a naïve buy-and-hold strategy was in fact simply a timing variant of the buy-and-hold rule. Fyfe, *et al.,* (1999: 183) therefore concluded that this result did "not provide sufficient grounds for the rejection of the efficient market hypothesis".

This result was confirmed by Ready (2002), who also utilized a genetic-algorithm approach to construct the best fit trading rules on daily closing price data of the Dow Jones Industrial Average (DJIA) over the 1945 – 1962 period. These trading rules were then tested over the subsequent 1963 – 1986 period and the returns were found to only roughly match the buy-and-hold benchmark.

In a later study, Miles and Smith (2010) expanded on the previous genetic programming approach studies of Fyfe, *et al*. and Ready, by applying more stringent thresholds to select the trading rules to be tested out-of-sample in order to improve their fitness. However, despite the improved robustness of their methodology, Miles and Smith still found that the rules did not outperform a simple buy-and-hold strategy.

2.9 Summary

Empirical evidence to date of qualitative charting and a plethora of exotic quantitative indicators and mechanical rules confirm the inability of trading rules generated by technical analysis to beat a naïve buy-and-hold strategy and invalidate the Weak-Form EMH.

3 RESEARCH QUESTION

Following the prior technical analysis studies which all support the Weak-Form EMH, technical analysis should prove to be a futile exercise, yet technical analysis has endured over time and is still an intensively and widely used investment analysis technique. In fact, in an extensive survey of 200 foreign exchange and international fund managers, Gehrig and Menkhoff (2006) found that technical analysts make up the largest group among foreign exchange traders and the second largest group among international fund managers.

This is a puzzling phenomenon, and begs the question:

Why would the majority of investment fund managers stubbornly persist in utilizing the apparently worthless endeavor of technical analysis?

and perhaps more importantly,

Why would investment banks and mutual funds continue to pay their fund managers multi-million-dollar compensation packages to pursue the nugatory practice of technical analysis?

This indicates a clear disconnect between technical analysis as employed by practitioners in the market and the technical analysis methodologies utilized by academics in prior Weak-Form EMH studies.

3.1 Problem Statement

The literature review has uncovered the following methodological weaknesses which suggest that previous technical analysis research findings were erroneous in being unable to reject the null Weak-Form market efficiency hypothesis:

3.1.1 Focus on Absolute Efficiency of Individual Capital Markets

All the prior technical analysis research focused exclusively on absolute tests supporting or rejecting the Weak-Form EMH with respect to an individual domestic stock or foreign exchange market. This was an entirely logical consequence of the fact that the majority of traders were restricted to trading their domestic markets due to geographical, technological, logistical and legal barriers - only a privileged few large institutional investors had the resources and capabilities to place limited international trades. Most studies also utilized data on the US stock market and the US dollar exchange rate since the US market is the deepest and most competitive financial market thereby providing the sternest test of the EMH.

However, in the past decade, the traditional domestic open-outcry pit stock market trading floor has become obsolete and has been replaced by linked international electronic exchanges, online trading platforms and high speed internet and data communications. This technological revolution has created a global trading marketplace which offers not only large institutional investors, but also small private traders

enhanced information dissemination and the opportunity to place and simultaneously execute daily trades in multiple global capital markets.

With the advent of this new global trading environment, the challenge of geopolitical, legislative, language, culture and currency differences could however conceivably act as a barrier to global information flows and result in exploitable pricing inefficiencies that will not be visible in an absolute individual capital market test. As posited by Blitz & Van Vliet (2008: 37), "capital markets are micro efficient, but global macro inefficient".

In addition, the EMH was originally formulated with respect to capital assets in general, yet its validity is tested almost exclusively in individual stock or foreign exchange market analyses. These methodological weaknesses are accentuated in the current global trading environment, thereby highlighting the need for a more integrated capital market efficiency approach which can be achieved through inter-market technical analysis.

As defined by Neely (1997), intermarket analysis involves the technical analysis of one capital market's price history in order to take a position in a related capital market and in today's global trading environment is therefore ideally positioned to enable a more integrated capital market efficiency approach.

Yet none of the prior technical analysis studies utilized inter-market analysis and all focused myopically on an individual domestic stock or foreign exchange market.

3.1.2 Qualitative or Quantitative Studies

Academics utilizing daily closing price data series are in most cases limited to testing quantitative mechanical trading rules which can be formulated mathematically. Consequently, they are unable to test subjective qualitative chart patterns which are non-linear and thus difficult to quantify, thereby sacrificing the information that a skilled chartist might discern from the data and the ability to determine the return generating potential of this form of technical analysis (Neely, 1997).

Additionally, as confirmed by Menkhoff and Taylor (2007), in practice technical analysts rely on a combination of qualitative and quantitative methods to generate their trading signals, nonetheless all prior technical analysis studies relied exclusively on either qualitative charting or quantitative mechanical rule methodologies, and none employed the more robust combination of qualitative and quantitative techniques.

3.1.3 Daily Closing Price Data Series

All previous technical analysis studies were restricted to utilizing daily closing price data bases, however as confirmed by Neely (1997) and Menkhoff and Taylor (2007), price fluctuations are smoothed out in long term daily, weekly or monthly price data series thereby rendering technical analysis less effective. In reality, long term daily data series are more applicable to fundamental analysis that utilizes

macroeconomic and firm specific microeconomic data as a basis to determine long term trading positions that last weeks, months and in some cases even years.

Technical analysis is therefore most effective as a short horizon intra-day trading technique where short term price fluctuations and trends are more easily discernible. Consequently, none of the prior technical analysis studies, which were limited to long term daily closing price data series, were therefore able to test more effective high frequency intra-day technical analysis strategies.

3.1.4 Volume Confirmation

Charles Dow was the first to propose the principle that a movement in the Dow Transport and Industrial Averages can only be confirmed if accompanied by high volume. In practice, technical analysts also assert that it is vital to use volume signals to confirm price movements (Osler and Chang, 1995), yet none of the prior technical analysis studies utilized volume as a confirmation filter in their trading rule methodologies.

3.2 Summary

Following the prior technical analysis studies which all support the Weak-Form EMH, technical analysis should prove to be a futile exercise, yet technical analysis has endured over time and is still an intensively and widely used investment analysis technique.

This indicates a clear disconnect between technical analysis as employed by practitioners in the market and the technical analysis methodologies utilized by academics in prior Weak-Form EMH studies.

The problem is that all previous technical analysis EMH research neglected to exploit inter-market technical analysis, the powerful combination of qualitative and quantitative techniques, high frequency intra-day strategies and volume confirmation signals in addition to focusing exclusively on individual domestic stock or currency markets.

These issues cumulatively result in methodological weaknesses which severely handicap the profit generating potential of technical analysis and suggest that previous Weak-Form EMH research findings were erroneous in being unable to reject the null Weak-Form market efficiency hypothesis.

4 METHODOLOGY

The Weak-Form EMH proposes that security prices at any point in time reflect all past historical information. Security prices therefore have no memory and the best estimate of a future price is the current price.

The weak form EMH therefore implies that technical analysis (which relies on charts and analysis of past price patterns to predict future price movements) would be of no value and cannot generate returns in excess of the market.

Following the literature review of prior research which all supported the Weak-Form EMH, technical analysis should prove to be a worthless activity, yet technical analysis has endured over time and is still an intensively and widely used investment analysis technique. In fact, in an extensive survey of 200 foreign exchange and international fund managers, Gehrig and Menkhoff (2006) found that technical analysts make up the largest group among foreign exchange traders and the second largest group among international fund managers.

This indicates a clear disconnect between technical analysis as employed by practitioners in the market and the technical analysis methodologies utilized by academics in prior Weak-Form EMH studies.

The problem is that all previous technical analysis EMH research neglected to exploit inter-market technical analysis, the powerful combination of qualitative and quantitative techniques, high frequency intra-day strategies and volume confirmation signals in addition to focusing exclusively on individual domestic stock or currency markets.

These issues cumulatively result in methodological weaknesses which severely handicap the profit generating potential of technical analysis and suggest that previous Weak-Form EMH research findings were erroneous in being unable to reject the null Weak-Form market efficiency hypothesis.

4.1 Hypothesis

This study therefore proposes that by eliminating prior methodological weaknesses and utilizing high frequency intra-day data, the combination of qualitative and quantitative techniques and volume signals to develop intermarket technical analysis strategies, it is possible to generate significant excess profits and consequently show that contrary to prior research findings, the developed country capital markets are not Weak-Form efficient.

Following Jensen (1967) and Malkiel (1995), the risk-adjusted portfolio excess performance can be measured through the traditional CAPM model:

$$R_{IP} - R_F = \alpha + \beta\,(R_{MKT} - R_F) + \varepsilon$$

where:

R_{IP} is the return on the Intermarket Portfolio

R_F is the risk-free rate of return as represented by the 3 month US Treasury Bill yield

R_{MKT} is the return on the market as represented by the S&P 500 Stock Index (SP)

β is the Intermarket Portfolio Beta

ε is the random error term

α is the intercept and designates Jensen's Alpha[5], simply abbreviated as Alpha. A positive Alpha (**α**) implies risk-adjusted performance in excess of the market that can be attributed to the portfolio manager. A naïve buy-and-hold policy can be expected to yield an Alpha (**α**) of zero and a manager underperforming the market will yield a negative Alpha (**α**).

4.1.1 The Null Hypothesis

The Null Hypothesis supports the Weak-Form EMH by stating, given all publicly available historical information, that a portfolio of Intermarket strategies cannot generate returns in excess of the market, thereby implying that the developed country capital markets are Weak-Form efficient:

$$H_0 : \alpha \leq 0$$

4.1.2 The Alternative Hypothesis

The Alternative Hypothesis states that a significantly positive Alpha α indicates risk-adjusted performance in excess of the market which implies that the developed country capital markets are not Weak-Form efficient:

$$H_1 : \alpha > 0$$

[5] The eponymous Jensen's Alpha was first used as a measure of mutual fund performance by Harvard Business School professor Michael Jensen in 1968.

4.2 Measurement Instruments

4.2.1 TradeStation Trading Platform

The TradeStation online trading platform was utilized to provide accurate market data and the ability to trade all major asset classes (Stocks, Bonds, Commodities and Forex) globally on a single platform, and is therefore ideally suited to testing inter-market technical analysis strategies. TradeStation received the Barron's Magazine 2011, 2012 and 2013 awards for best online broker and best trading platform.

4.2.2 EasyLanguage

EasyLanguage, the built in programming language facility in TradeStation, enabled the development, back-testing and automation of trading strategy codes based on user defined trading strategies.

4.2.3 CSI Correlation Lab

The CSI Correlation Lab software analyzes over 5 billion market pairs each day, and computes the level of correlation between such pairs over periods of daily information that range from 2 years to 30 years into the past. The CSI Correlation Lab software was thus utilized to confirm the Inter-market relationships that formed the foundation of the Inter-market momentum trading strategies.

4.2.4 IBM SPSS Statistics Software

The data was statistically analyzed and the regression analysis performed utilizing the IBM SPSS Statistical Software package.

4.3 Measurement Techniques

Following the research objective of this study, high frequency intra-day data, the combination of qualitative and quantitative techniques and volume signals were utilized to develop intermarket technical analysis strategies that generate significant excess profits and consequently show that the developed country capital markets are not Weak-Form efficient.

4.3.1 Intermarket Analysis

Intermarket analysis, where the technical analysis of one markets price history is used to take positions in another related market (Neely, 1997), is ideally positioned to enable a more integrated global capital market efficiency approach that would expose pricing inefficiencies arising from geopolitical, legislative, language, culture and currency barriers to global information flows. The intermarket analysis trading

strategies were built on the basis of the intermarket relationships identified by Ruggiero (1997) – information that would thereafter be well known and available to traders over the past fifteen years.

4.3.2 Momentum Indicator (MOM)

The trend following Momentum Indicator (MOM) represented the technical analysis used in the inter-market analysis strategies to identify price breakouts and the development of price trends in the traded market under the technical analysis maxim "momentum precedes price". Additionally, there is also strong empirical support (Jegadeesh and Titman, 1993) for asset prices to exhibit short term momentum.

The standard Momentum Indicator (MOM) trading rules as defined below were utilized to identify trade entries, trade entry filters, and trade exits in all of the inter-market trading strategies:

Buy: ***MOM(t-1) < 0 and MOM(t) > 0***

Sell: ***MOM(t-1) > 0 and MOM(t) < 0***

Thus, a buy (sell) signal is triggered when the MOM crosses the zero line from below (above).

The Momentum Indicator was developed by J. Welles Wilder[6] in the late 1970's and has since been used extensively by technical analysis practitioners. As in the case of Inter-market analysis, these trading rules were formulated prior to the time period in this study over which they were tested, and therefore represented information that was well known and readily available to traders during the test period.

4.3.3 High Frequency Data

As confirmed by Neely (1997) and Menkhoff and Taylor (2007), price fluctuations are smoothed out in long term daily, weekly or monthly price data series thereby rendering technical analysis less effective. Therefore, high frequency 240-minute intra-day data was utilized for both the dependent traded market and the independent intermarket data in order to more effectively detect short term price fluctuations and trends.

4.3.4 Volume

In practice, technical analysts assert that it is vital to use volume signals to confirm price movements (Osler and Chang, 1995). Volume can be measured by a Volume Oscillator[7] indicator that calculates the difference between a fast 28 day moving average of volume and a slow 14 day moving average of volume, and the result is then plotted as a histogram. The histogram fluctuates above and below a zero line, with positive values above the zero line indicating high volume and market conviction.

[6] [6] *Source: www.investopedia.com*

[7] Source: www.metastock.com

Consequently, a Volume Oscillator indicator was applied to the traded market and built into the EasyLanguage trading code to act as a volume confirmation filter and ensure that trades are only entered into when the Volume Oscillator value is greater than zero. This is an indication of high volume which suggests that there is enough market support to drive the asset price in the direction of the trend.

4.3.5 Qualitative Charting

Finally, each individual trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout. As posited by Neely (1997), subjective qualitative chart patterns are non-linear and thus difficult to quantify, but excluding chart analysis would not only sacrifice the information that a skilled chartist might discern from the data, but also the ability to determine the return generating potential of this form of technical analysis. Additionally, as confirmed by Menkhoff and Taylor (2007), in practice technical analysts rely on a combination of qualitative and quantitative methods to generate their trading signals.

4.4 *Ex Ante* Study

The Intermarket Momentum strategies were therefore developed utilizing technical analysis momentum trading rules and inter-market relationships formulated and identified on data prior to the time period in this study over which they were tested, and therefore represented information that was well known and readily available to traders during the test period.

The *ex ante* nature of this study is in contrast to most technical analysis studies that test trading rules *ex post* on prior historical data.

This *ex ante* study therefore more closely follows Brown (2011: 87), who posited that in order to establish a violation of the EMH it is necessary to "show the profitability of a trading strategy based on information available at the time the trades are made."

4.5 Strategy Automation

For each respective Intermarket Momentum trading strategy, EasyLanguage was utilized to develop a trading strategy code that would build in and automate the trade entry rules, intermarket and volume confirmation trade entry filters, and the trade exit rules.

The trading strategy codes were then inserted into their respective TradeStation workspaces whereupon they automatically execute on the workspace data.

4.5.1 Strategy Performance Testing

TradeStation generates accurate trade lists and strategy performance reports by allowing the user to input realistic market related trade strategy properties into the trading strategy code.

The following trade strategy properties were built into each trading strategy code:

4.5.1.1 Broker Commission:

The actual broker commissions charged per trade by TradeStation to place and execute buy and sell Futures orders were built into the trading strategy codes:

Australian Dollar (AD):	$ 1.60 per contract
Canadian Dollar (CD):	$ 1.60 per contract
South African Rand (RA):	$ 1.60 per contract
Norwegian Krone (NOK):	$ 1.60 per contract
Commodity Index (GI):	$ 1.35 per contract
Gold (GC):	$ 1.45 per contract
Silver (SI):	$ 1.45 per contract
Platinum (PL):	$ 1.45 per contract
Crude Oil (CL):	$ 1.45 per contract
30 Year US Treasury Bond (US):	$ 1.60 per contract

4.5.1.2 Slippage:

Slippage refers to the difference in price between the time an order is placed and when it is actually executed due to the time lag experienced before another trader takes the other side of a buy or sell trade, thereby effectively filling the order. Positive slippage occurs when the final execution price is better than the requested price, but in most cases, slippage is negative and results in disadvantageous prices. It is therefore built in as a cost per trade and following Ruggiero (1997), slippage of $ 50.00 per trade is a realistic estimate of slippage costs over an extended trading period.

4.5.1.3 Trade Size:

Approximately 10% of the portfolio capital was invested in each individual trade which translated into an initial trade size of $ 100 000.00 per trade or the equivalent number of Futures contracts.

4.5.1.4 Interest Rate:

Interest Rate refers to the interest earned on trading capital while not actively in a trade. In the light of the historically low 0 – 0.25% Federal Reserve Funds Rate since the 2008 Financial Crisis, TradeStation not surprisingly offers a credit interest rate of 0.0% on incremental trading capital balances over $ 10 000.00. Therefore, a 0% interest rate was built into the trading strategy codes.

4.6 Portfolio Construction

A naïve investment portfolio comprising ten Intermarket Momentum strategies was constructed with an initial capital of $ 1 million. In order to adhere with prudent investment portfolio risk management guidelines, approximately 10% of the portfolio capital was invested in each individual trade which translated into an initial trade size of $ 100 000.00 per trade.

The traditional CAPM model was used to calculate the risk-adjusted return on the Intermarket Momentum portfolio and test the Null Hypothesis that the portfolio of Intermarket strategies cannot generate returns in excess of the market, thereby implying that the developed country capital markets are Weak-Form efficient.

4.7 Summary

Following the research objective of this study, Intermarket relationships, the Momentum indicator trading rules, high frequency intra-day data, qualitative charting and volume signals were utilized to develop a portfolio of ten Intermarket Momentum trading strategies.

The Momentum indicator trading rules and Intermarket relationships utilized in the development of the trading strategies were formulated and identified on data prior to the time period in this study over which the strategies were tested, and therefore represented information that was well known and readily available to traders during the test period.

5 DATA

5.1 Data Collection

TradeStation provides an extensive historical database of up to 60 years of clean and accurate daily, intraday and tick data for Indices, Stocks, Options, Futures and Forex as outlined in Table 5-1.

The availability of years and even decades of accurate historical data enables the back-testing of trading strategies across bull and bear market cycles. This is a valuable characteristic of the TradeStation historical database since as noted by Ruggiero (1997), in order to construct a robust trading strategy, it is recommended that the data set include both a bull and a bear market.

TradeStation's superior data accuracy[8] is maintained by using three filtering mechanisms - as a first layer of defense, erroneous data is caught in real-time by automated filtering mechanisms. As a second layer of defense, data is corrected in real-time by the financial exchanges themselves, and as a third layer of defense, data is manually maintained in-house by using an expert team of market data professionals.

Table 5-1: TradeStation Historical Market Data

	DAILY	INTRADAY	TICK
US Stocks & ETFs	43+ Years	20+ Years	6 Months
US Stock Options, Index Options, & Futures Options	Entire Contract Life		
US Futures	61+ Years	27+ Years	
US Indices	40+ Years*	27+ Years	
German Stocks	11+ Years	11+ Years	
Eurex Stocks	12+ Years	12+ Years	
German Indices	12+ Years	12+ Years	
Forex	40+ Years	8+ Years	

Source: www.tradestation.com

[8] Source: www.tradestation.com

5.2 Data Analysis

5.2.1 Trading the Commodity Currencies

Intermarket relationships as identified by Ruggiero (1997) were utilized to develop Intermarket Momentum trading strategies for the commodity currencies - the currencies of commodity rich countries whose economies rely heavily on their commodity exports, such as Australia (Australian Dollar), Canada (Canadian Dollar), South Africa (Rand) and Norway (Norwegian Krone).

5.2.1.1 The Trade Strategy Premise

The US Dollar is the international reserve currency therefore commodities are priced and traded in US Dollars worldwide. In periods of dollar weakness, commodity producers will raise prices to compensate for the eroded value of their dollar denominated commodity receipts. Conversely, in periods of dollar strength commodity prices will fall therefore in general one can expect that the US Dollar will exhibit a strong negative correlation with Commodity prices and the price of Gold.

Ruggiero (1997: 21) illustrates with the aid of graphs the intermarket relationship that clearly shows the US Dollar being negatively correlated with Commodities and Gold.

Consequently, fluctuations in commodity prices will have a direct valuation effect on the commodity currencies. A rise in commodity prices will increase demand for the commodity currencies from importing nations, resulting in an appreciation of the commodity currencies in the global foreign exchange markets. Based on the inverse relationship between the US Dollar and commodities, it therefore follows that a depreciation in the US Dollar will result in rising commodity prices and an appreciation of the commodity currencies. The converse is also true: an appreciation of the US Dollar will lower commodity prices and depreciate the commodity currencies.

Ruggiero (1997) also identifies a positive relationship between US Treasury Bonds and foreign currencies on the basis of the inverse relationship between bond prices and yields - as US Treasury Bond prices rise, bond yields fall with the result that interest rates also decline making US Dollar based assets less attractive to investors. The US Dollar therefore declines and foreign currencies gain a competitive edge - this results in an expected positive intermarket relationship between 30 year US Treasury Bonds, 10 year US Treasury Notes, the Eurodollar (a measure of short-term interest rates), and the commodity currencies.

The afore-mentioned negative intermarket correlations between the US Dollar (DX) and Commodities (GI), Gold (GC), and the commodity currencies Australian Dollar (AD), Canadian Dollar (CD), South African Rand (RA) and Norwegian Krone (NOK); and the positive intermarket correlations between the commodity currencies and Commodities (GI), Gold (GC) and US Treasury Bonds (US) were confirmed by the correlation lab software of CSI Commodity Systems Inc. as detailed over-page in Table 5-2:

Table 5-2: Correlation Coefficients - Commodity Currencies Intermarket Relationships

NO. OF YEARS BACK	MARKET	MARKET	CORRELATION COEFFICIENT
15 Years	DX	GI	-0.89
15 Years	DX	GC	-0.88
15 Years	DX	AD	-0.94
15 Years	DX	CD	-0.93
5 Years	DX	RA	-0.66
10 Years	DX	NOK	-0.92
15 Years	GI	AD	+0.91
15 Years	GI	CD	+0.95
2 Years	GI	RA	+0.48
10 Years	GI	NOK	+0.88
15 Years	GC	AD	+0.93
15 Years	GC	CD	+0.92
2 Years	GC	RA	+0.61
10 Years	GC	NOK	+0.67
15 Years	US	AD	+0.72
15 Years	US	CD	+0.78
10 Years	US	NOK	+0.44

Source: CSI Commodity Systems Inc.

5.2.2 The Australian Dollar Strategy

Australia is globally one of the largest producers of agricultural, metal and mineral commodities, therefore one would expect a strong positive relationship between the Australian Dollar, Commodities and Gold. Consequently, following the negative correlation between the US Dollar and Commodities, one would also expect a strong negative relationship between the US Dollar and the Australian Dollar.

As previously detailed, a rise in US Treasury Bond prices will drive down bond yields and interest rates thereby making US Dollar based assets less attractive to investors. International capital then flows into foreign assets, the US Dollar therefore declines and foreign currencies gain a competitive edge with the Australian Dollar being one of the main beneficiaries due to its traditionally strong economy and stable political climate. This results in an expected positive inter-market relationship between the Australian Dollar and 30 year US Treasury Bonds, 10 year US Treasury Notes, and the Eurodollar (a measure of short-term interest rates).

5.2.2.1 The Trade Data

The above identified intermarket relationships form the dependent traded market and independent intermarket data utilized in the development of an Intermarket Momentum trading strategy for the Australian Dollar.

The trade data are detailed below in Table 5-3:

Table 5-3: Traded Market and Intermarket Data - Australian Dollar Strategy

DEPENDENT TRADED MARKET	TRADESTATION SYMBOL	INTRA-DAY HISTORICAL DATA
Australian Dollar Custom Continuous Futures Contract	AD	As of 05/02/2001
INDEPENDENT INTER-MARKET CURRENCIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
US Dollar Index Custom Continuous Futures Contract	DX	As of 09/23/2004
Canadian Dollar Custom Continuous Futures Contract	CD	As of 05/02/2001
South African Rand Custom Continuous Futures Contract	RA	As of 12/01/2004
Norwegian Krone Custom Continuous Futures Contract	NOK	As of 11/10/2003
INDEPENDENT INTER-MARKET COMMODITIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
S&P GSCI Commodity Index	GI	As of 08/16/2001
Gold Custom Continuous Contract	GC	As of 10/22/2002
INDEPENDENT INTER-MARKET BONDS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
30 Yr. US Treasury Bond Custom Continuous Futures Contract	US	As of 10/25/2002
10 Yr. US Treasury Note Custom Continuous Futures Contract	TY	As of 09/30/2002
Eurodollar Custom Continuous Futures Contract	ED	As of 09/27/1994

Source: The Author, 2013

5.2.2.2 The Data Sample Period

Test set: Intra-day 240-minute data from May 2, 2001 – December 31, 2012

Live set: Intra-day 240-minute data from January 1, 2013 – present

5.2.2.3 The Trade Entry Rules

Breakout and price trend movements in the dependent traded market were identified by the standard Momentum (MOM) Indicator trading rule whereby a buy (sell) signal is triggered when the MOM crosses the zero line from below (above). Therefore, the following long and short MOM based trade entry rules were developed for the Australian Dollar (AD):

Buy: AD MOM(t-1) < 0 and AD MOM(t) > 0

If the Australian Dollar Momentum crosses over the zero line from below, initiate a long position (buy) the dependent traded market Australian Dollar.

Sell: AD MOM(t-1) > 0 and AD MOM(t) < 0

If the Australian Dollar Momentum crosses under the zero line from above, initiate a short position (sell short) the dependent traded market Australian Dollar.

5.2.2.4 Entry Rule Filters

Australian Dollar intermarket correlations, volume confirmation and qualitative charting analysis were used to build trade entry rule filters to ensure that trades will only be entered into during those periods where Australian Dollar price movement is supported by price trends in the independent intermarkets, high volume in the Australian Dollar market and a supporting chart pattern or trendline breakout.

Intermarket Correlations:

Table 5-4: Intermarket Correlation Coefficients – Australian Dollar (AD)

	AD	DX	CD	RA	NOK	GI	GC	US	TY	ED
AD	**1.00**									
DX	**-0.94**	1.00								
CD	**+0.96***	-0.93	1.00							
RA	**+0.33**	-0.66	+0.46	1.00						
NOK	**+0.84**	-0.92	+0.88	+0.42	1.00					
GI	**+0.91**	-0.89	+0.95*	+0.48	+0.88	1.00				
GC	**+0.93**	-0.88	+0.92	+0.61	+0.67	+0.92	1.00			
US	**+0.72**	-0.76	+0.78	-0.19	+0.44	+0.82	+0.91	1.00		
TY	**+0.74**	-0.70	+0.70	-0.13	+0.39	+0.75	+0.86	+0.96*	1.00	
ED	**+0.58**	-0.50	+0.51	+0.14	+0.52	+0.55	+0.71	+0.78	+0.89	1.00

Source: CSI Commodity Systems Inc.

As illustrated above in Table 5-4, the intermarket correlations between the Australian Dollar (AD) and the US Dollar Index (DX), the Commodity Currencies (CD, RA and NOK), Commodities (GI), Gold (GC), and US

Treasury Bonds (US, TY and ED) were utilized to build trade entry rule filters as follows: an Australian Dollar long position was only initiated if it was supported by rising price momentum (MOM > 0) in the positively correlated independent intermarkets:

Commodity Currencies

Canadian Dollar (CD) - Correlation Coefficient +0.96

South African Rand (RA) - Correlation Coefficient +0.33

Norwegian Krone (NOK) - Correlation Coefficient +0.84

Commodities

S&P GSCI Commodity Index (GI) - Correlation Coefficient +0.91

Gold (GC) - Correlation Coefficient +0.93

US Treasury Bonds

30 Yr. US Treasury Bond (US) - Correlation Coefficient +0.72

10 Yr. US Treasury Note (TY) – Correlation Coefficient +0.74

Eurodollar (ED) - Correlation Coefficient +0.58

and falling price momentum (MOM < 0) in the negatively correlated independent intermarkets:

US Dollar Index (DX) - Correlation Coefficient -0.94

Conversely, an Australian Dollar short position was only initiated if it was supported by falling price momentum (MOM < 0) in the positively correlated independent intermarkets and rising price momentum (MOM > 0) in the negatively correlated independent intermarkets.

Volume:

A volume confirmation filter was utilized to ensure that Australian Dollar long and short positions were only initiated when there was high volume in the Australian Dollar market (AD Volume Oscillator > 0) which suggests that there is enough market support to continue driving the Australian Dollar price in the direction of the momentum trend.

Qualitative Charting:

Each individual Australian Dollar trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Therefore,

Only initiate an Australian Dollar (AD) long position if:

The US Dollar Index (DX) MOM < 0

The South African Rand (RA) MOM > 0

The Canadian Dollar (CD) MOM > 0

The Norwegian Krone (NOK) MOM > 0

The Commodity Index (GI) MOM > 0

Gold (GC) MOM > 0

The 30 year US Treasury Bond (US) MOM > 0

The 10 year US Treasury Note (TY) MOM > 0

The Eurodollar (ED) MOM > 0

The Australian Dollar Volume Oscillator (Volume Osc) > 0 and

Finally, each individual long trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Only initiate an Australian Dollar (AD) short position if:

The US Dollar Index (DX) MOM > 0

The South African Rand (RA) MOM < 0

The Canadian Dollar (CD) MOM < 0

The Norwegian Krone (NOK) MOM < 0

The Commodity Index (GI) MOM < 0

Gold (GC) MOM < 0

The 30 year US Treasury Bond (US) MOM < 0

The 10 year US Treasury Note (TY) MOM < 0

The Eurodollar (ED) MOM < 0

The Australian Dollar Volume Oscillator (Volume Osc) > 0 and

Finally, each individual short trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

5.2.2.5 Trade Exit Rules

The Australian Dollar Momentum Indicator was used to signal trend reversals and the necessity to exit the trade position.

In a long Australian Dollar (AD) position:

If the Australian Dollar (AD) MOM crosses below the zero line, sell to close out the position.

In a short Australian Dollar (AD) position:

If the Australian Dollar (AD) MOM crosses above the zero line, buy to cover and close out the position.

5.2.2.6 Setting Up the Australian Dollar Strategy TradeStation Workspace

Intra-day 240-minute data charts of the Australian Dollar (AD), South African Rand (RA), the Canadian Dollar (CD), the Norwegian Krone (NOK), the Commodity Index (GI), the US Dollar Index (DX), Gold (GC), the 30 year US Treasury Bond (US), the 10 year US Treasury Note (TY), and the Eurodollar (ED) for the period May 2, 2001 – Present were inserted into a TradeStation workspace.

An Australian Dollar Volume Oscillator (Volume Osc) was applied in a sub-graph below the main chart, as illustrated by a snapshot of the TradeStation Workspace in Figure 5-1 overpage:

Figure 5-1: Australian Dollar Strategy - TradeStation Workspace

Source: TradeStation, 2013

5.2.3 The Canadian Dollar Strategy

Canada has vast resources of oil, natural gas and timber, therefore the Canadian Dollar is highly sensitive to commodity prices and experiences the same inter-market relationships as its commodity currency partner, the Australian Dollar.

5.2.3.1 The Trade Data

The intermarket relationships identified for the Australian Dollar also form the dependent traded market and independent inter-market data utilized in the development of an Intermarket Momentum trading strategy for the Canadian Dollar.

The trade data are detailed below in Table 5-5:

Table 5-5: Traded Market and Intermarket Data - Canadian Dollar Strategy

DEPENDENT TRADED MARKET	TRADESTATION SYMBOL	INTRA-DAY HISTORICAL DATA
Canadian Dollar Custom Continuous Futures Contract	CD	As of 05/02/2001
INDEPENDENT INTER-MARKET CURRENCIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
US Dollar Index Custom Continuous Futures Contract	DX	As of 09/23/2004
Australian Dollar Custom Continuous Futures Contract	AD	As of 05/02/2001
South African Rand Custom Continuous Futures Contract	RA	As of 12/01/2004
Norwegian Krone Custom Continuous Futures Contract	NOK	As of 11/10/2003
INDEPENDENT INTER-MARKET COMMODITIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
S&P GSCI Commodity Index	GI	As of 08/16/2001
Gold Custom Continuous Contract	GC	As of 10/22/2002
INDEPENDENT INTER-MARKET BONDS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
30 Yr. US Treasury Bond Custom Continuous Futures Contract	US	As of 10/25/2002
10 Yr. US Treasury Note Custom Continuous Futures Contract	TY	As of 09/30/2002
Eurodollar Custom Continuous Futures Contract	ED	As of 09/27/1994

Source: The Author, 2013

5.2.3.2 The Data Sample Period

Test set: Intra-day 240-minute data from May 2, 2001 – December 31, 2012

Live set: Intra-day 240-minute data from January 1, 2013 – present

5.2.3.3 The Trade Entry Rules

Breakout and price trend movements in the dependent traded market were identified by the standard Momentum (MOM) Indicator trading rule, resulting in the following long and short MOM based trade entry rules for the Canadian Dollar (CD):

Buy: CD MOM(t-1) < 0 and CD MOM(t) > 0

If the Canadian Dollar Momentum crosses over the zero line from below, initiate a long position (buy) the dependent traded market Canadian Dollar.

Sell: CD MOM(t-1) > 0 and CD MOM(t) < 0

If the Canadian Dollar Momentum crosses under the zero line from above, initiate a short position (sell short) the dependent traded market Canadian Dollar.

5.2.3.4 Entry Rule Filters

Canadian Dollar intermarket correlations, volume confirmation and qualitative charting analysis were used to build trade entry rule filters to ensure that trades will only be entered into during those periods where Canadian Dollar price movement is supported by price trends in the independent intermarkets, high volume in the Canadian Dollar market and a supporting chart pattern or trendline breakout.

Intermarket Correlations:

Table 5-6: Intermarket Correlation Coefficients – Canadian Dollar (CD)

	CD	DX	AD	RA	NOK	GI	GC	US	TY	ED
CD	**1.00**									
DX	**-0.93**	1.00								
AD	**+0.96***	-0.93	1.00							
RA	**+0.46**	-0.66	+0.33	1.00						
NOK	**+0.88**	-0.92	+0.84	+0.42	1.00					
GI	**+0.95***	-0.89	+0.91	+0.48	+0.88	1.00				
GC	**+0.92**	-0.88	+0.93	+0.61	+0.67	+0.92	1.00			
US	**+0.78**	-0.76	+0.72	-0.19	+0.44	+0.82	+0.91	1.00		
TY	**+0.70**	-0.70	+0.74	-0.13	+0.39	+0.75	+0.86	+0.96*	1.00	
ED	**+0.51**	-0.50	+0.58	+0.14	+0.52	+0.55	+0.71	+0.78	+0.89	1.00

Source: CSI Commodity Systems Inc.

As illustrated in Table 5-6, the intermarket correlations between the Canadian Dollar (CD) and the US Dollar Index (DX), the Commodity Currencies (AD, RA and NOK), Commodities (GI), Gold (GC), and US Treasury Bonds (US, TY and ED) were utilized to build trade entry rule filters whereby a Canadian Dollar long position was only initiated if it was supported by rising price momentum (MOM > 0) in the positively correlated independent intermarkets and falling price momentum (MOM < 0) in the negatively correlated independent intermarkets. Conversely, a Canadian Dollar short position was only initiated if it was supported by falling price momentum (MOM < 0) in the positively correlated independent intermarkets and rising price momentum (MOM > 0) in the negatively correlated independent intermarkets.

Volume:

A volume confirmation filter was utilized to ensure that Canadian Dollar long and short positions were only initiated when there was high volume in the Canadian Dollar market (CD Volume Oscillator > 0) which suggests that there is enough market support to continue driving the Canadian Dollar price in the direction of the momentum trend.

Qualitative Charting:

Each individual Canadian Dollar trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Therefore,

Only initiate a Canadian Dollar (CD) long position if:

The US Dollar Index (DX) MOM < 0

The Australian Dollar (AD) MOM > 0

The South African Rand (RA) MOM > 0

The Norwegian Krone (NOK) MOM > 0

The Commodity Index (GI) MOM > 0

Gold (GC) MOM > 0

The 30 year US Treasury Bond (US) MOM > 0

The 10 year US Treasury Note (TY) MOM > 0

The Eurodollar (ED) MOM > 0

The Canadian Dollar Volume Oscillator (Volume Osc) > 0 and

Finally, each individual long trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Only initiate a Canadian Dollar (CD) short position if:

The US Dollar Index (DX) MOM > 0

The Australian Dollar (AD) MOM < 0

The South African Rand (RA) MOM < 0

The Norwegian Krone (NOK) MOM < 0

The Commodity Index (GI) MOM < 0

Gold (GC) MOM < 0

The 30 year US Treasury Bond (US) MOM < 0

The 10 year US Treasury Note (TY) MOM < 0

The Eurodollar (ED) MOM < 0

The Canadian Dollar Volume Oscillator (Volume Osc) > 0 and

Finally, each individual short trade identified by the inter-market strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

5.2.3.5 Trade Exit Rules

The Canadian Dollar Momentum Indicator was used to signal trend reversals and the necessity to exit the trade position.

In a long Canadian Dollar (CD) position:

If the Canadian Dollar (CD) MOM crosses below the zero line, sell to close out the position.

In a short Canadian Dollar (CD) position:

If the Canadian Dollar (CD) MOM crosses above the zero line, buy to cover and close out the position.

5.2.3.6 Setting Up the Canadian Dollar Strategy TradeStation Workspace

Intra-day 240-minute data charts of the Canadian Dollar (CD), the Australian Dollar (AD), South African Rand (RA), the Norwegian Krone (NOK), the Commodity Index (GI), the US Dollar Index (DX), Gold (GC), the 30 year US Treasury Bond (US), the 10 year US Treasury Note (TY), and the Eurodollar (ED) for the period May 2, 2001 – Present were inserted into a TradeStation workspace.

A Canadian Dollar Volume Oscillator (Volume Osc) was applied in a sub-graph below the main chart, as illustrated by a snapshot of the TradeStation Workspace in Figure 5-2 below:

Figure 5-2: Canadian Dollar Strategy - TradeStation Workspace

Source: TradeStation, 2013

5.2.4 The South African Rand Strategy

South Africa is blessed with vast resources of mineral commodities. Although gold production has declined in the past two decades, South Africa is still the world's largest producer of gold behind China, accounts for 77% of the world's supply of platinum, is the third largest producer of coal, and is a significant player in the diamond, iron ore and chromium industries[9]. Not surprisingly therefore, the South African Rand is closely linked to commodity prices and experiences the same intermarket relationships as the other commodity currencies.

5.2.4.1 The Trade Data

The commodity currency inter-market relationships also form the dependent traded market and independent inter-market data utilized in the development of an Intermarket Momentum trading strategy for the South African Rand.

The trade data are detailed below in Table 5-7:

Table 5-7: Traded Market and Intermarket Data - South African Rand Strategy

DEPENDENT TRADED MARKET	TRADESTATION SYMBOL	INTRA-DAY HISTORICAL DATA
South African Rand Custom Continuous Futures Contract	RA	As of 12/01/2004
INDEPENDENT INTER-MARKET CURRENCIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
US Dollar Index Custom Continuous Futures Contract	DX	As of 09/23/2004
Australian Dollar Custom Continuous Futures Contract	AD	As of 05/02/2001
Canadian Dollar Custom Continuous Futures Contract	CD	As of 05/02/2001
Norwegian Krone Custom Continuous Futures Contract	NOK	As of 11/10/2003
INDEPENDENT INTER-MARKET COMMODITIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
S&P GSCI Commodity Index	GI	As of 08/16/2001
Gold Custom Continuous Contract	GC	As of 10/22/2002
INDEPENDENT INTER-MARKET BONDS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
30 Yr. US Treasury Bond Custom Continuous Futures Contract	US	As of 10/25/2002
10 Yr. US Treasury Note Custom Continuous Futures Contract	TY	As of 09/30/2002
Eurodollar Custom Continuous Futures Contract	ED	As of 09/27/1994

Source: The Author, 2013

5.2.4.2 The Data Sample Period

Test set: Intra-day 240-minute data from December 1, 2004 – December 31, 2012

Live set: Intra-day 240-minute data from January 1, 2013 – present

[9] *Source: CommodityHQ.com*

5.2.4.3 The Trade Entry Rules

Breakout and price trend movements in the dependent traded market were identified by the standard Momentum (MOM) Indicator trading rule, resulting in the following long and short MOM based trade entry rules for the South African Rand (RA):

Buy: RA MOM(t-1) < 0 and RA MOM(t) > 0

If the South African Rand Momentum crosses over the zero line from below, initiate a long position (buy) the dependent traded market South African Rand.

Sell: RA MOM(t-1) > 0 and RA MOM(t) < 0

If the South African Rand Momentum crosses under the zero line from above, initiate a short position (sell short) the dependent traded market South African Rand.

5.2.4.4 Entry Rule Filters

South African Rand intermarket correlations, volume confirmation and qualitative charting analysis were used to build trade entry rule filters to ensure that trades will only be entered into during those periods where South African Rand price movement is supported by price trends in the independent intermarkets, high volume in the South African Rand market and a supporting chart pattern or trendline breakout.

Intermarket Correlations:

Table 5-8: Intermarket Correlation Coefficients – South African Rand (RA)

	RA	DX	AD	CD	NOK	GI	GC	US	TY	ED
RA	**1.00**									
DX	**-0.66**	1.00								
AD	**+0.33**	-0.94	1.00							
CD	**+0.46**	-0.93	+0.96*	1.00						
NOK	**+0.42**	-0.92	+0.84	+0.88	1.00					
GI	**+0.48**	-0.89	+0.91	+0.95*	+0.88	1.00				
GC	**+0.61**	-0.88	+0.93	+0.92	+0.67	+0.92	1.00			
US	**-0.19**	-0.76	+0.72	+0.78	+0.44	+0.82	+0.91	1.00		
TY	**-0.13**	-0.70	+0.74	+0.70	+0.39	+0.75	+0.86	+0.96*	1.00	
ED	**+0.14**	-0.50	+0.58	+0.51	+0.52	+0.55	+0.71	+0.78	+0.89	1.00

Source: CSI Commodity Systems Inc.

As illustrated in Table 5-8, the intermarket correlations between the South African Rand (RA) and the US Dollar Index (DX), the Commodity Currencies (AD, CD and NOK), Commodities (GI), Gold (GC), and US Treasury Bonds (US, TY and ED) were utilized to build trade entry rule filters whereby a South African Rand long position was only initiated if it was supported by rising price momentum (MOM > 0) in the positively correlated independent intermarkets and falling price momentum (MOM < 0) in the negatively correlated independent intermarkets. Conversely, a South African Rand short position was only initiated if it was supported by falling price momentum (MOM < 0) in the positively correlated independent intermarkets and rising price momentum (MOM > 0) in the negatively correlated independent intermarkets.[10]

Volume:

A volume confirmation filter was utilized to ensure that South African Rand long and short positions were only initiated when there was high volume in the South African Rand market (RA Volume Oscillator > 0) which suggests that there is enough market support to continue driving the South African Rand price in the direction of the momentum trend.

Qualitative Charting:

Each individual South African Rand trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Therefore,

Only initiate a South African Rand (RA) long position if:

The US Dollar Index (DX) MOM < 0

The Australian Dollar (AD) MOM > 0

The Canadian Dollar (CD) MOM > 0

The Norwegian Krone (NOK) MOM > 0

The Commodity Index (GI) MOM > 0

Gold (GC) MOM > 0

The 30 year US Treasury Bond (US) MOM > 0

The 10 year US Treasury Note (TY) MOM > 0

[10] Unlike its commodity currency partners, surprisingly the South African Rand exhibited a weak correlation to US Treasury Bonds. However, for the purpose of this study, a positive RA / US Treasury Bond correlation will be utilized as a trade entry filter due to the positive correlation between RA and its commodity currency partners and their correspondingly strong positive correlation to US Treasury Bonds.

The Eurodollar (ED) MOM > 0

The South African Rand Volume Oscillator (Volume Osc) > 0 and

Finally, each individual long trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Only initiate a South African Rand (RA) short position if:

The US Dollar Index (DX) MOM > 0

The Australian Dollar (AD) MOM < 0

The Canadian Dollar (CD) MOM < 0

The Norwegian Krone (NOK) MOM < 0

The Commodity Index (GI) MOM < 0

Gold (GC) MOM < 0

The 30 year US Treasury Bond (US) MOM < 0

The 10 year US Treasury Note (TY) MOM < 0

The Eurodollar (ED) MOM < 0

The South African Rand Volume Oscillator (Volume Osc) > 0 and

Finally, each individual short trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

5.2.4.5 Trade Exit Rules

The South African Rand Momentum Indicator was used to signal trend reversals and the necessity to exit the trade position.

In a long South African Rand (RA) position:

If the South African Rand (RA) MOM crosses below the zero line, sell to close out the position.

In a short South African Rand (RA) position:

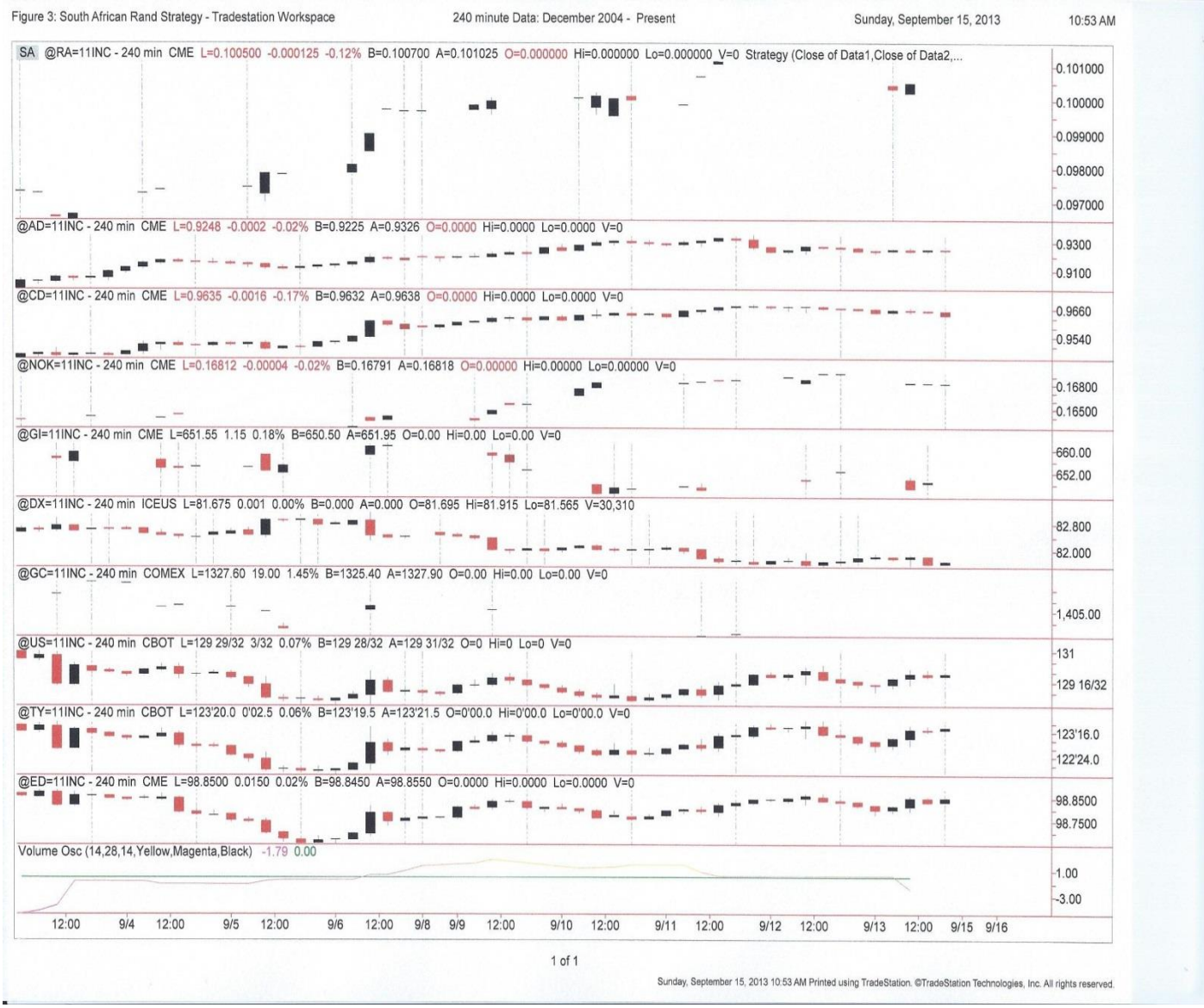
If the South African Rand (RA) MOM crosses above the zero line, buy to cover and close out the position.

5.2.4.6 Setting Up the South African Rand Strategy TradeStation Workspace

Intra-day 240-minute data charts of the South African Rand (RA), Australian Dollar (AD), Canadian Dollar (CD), the Norwegian Krone (NOK), the Commodity Index (GI), the US Dollar Index (DX), Gold (GC), the 30 year US Treasury Bond (US), the 10 year US Treasury Note (TY), and the Eurodollar (ED) for the period December 1, 2004 – Present were inserted into a TradeStation workspace.

A South African Rand Volume Oscillator (Volume Osc) was applied in a sub-graph below the main chart, as illustrated by a snapshot of the TradeStation Workspace in Figure 5-3 below:

Figure 5-3: South African Rand Strategy - TradeStation Workspace



Source: TradeStation, 2013

5.2.5 The Norwegian Krone Strategy

Norway has an abundance of natural resources with offshore oil exploration and production playing a major role. Since the discovery of oil and gas reserves in the 1960s, Norway has developed into the world's third largest oil exporter elevating its currency, the Norwegian Krone, into the realm of the commodity currencies[11].

5.2.5.1 The Trade Data

The commodity currency inter-market relationships form the dependent traded market and independent inter-market data utilized in the development of an Intermarket Momentum trading strategy for the Norwegian Krone.

The trade data are detailed below in Table 5-9:

Table 5-9: Traded Market and Intermarket Data - Norwegian Krone Strategy

DEPENDENT TRADED MARKET	TRADESTATION SYMBOL	INTRA-DAY HISTORICAL DATA
Norwegian Krone Custom Continuous Futures Contract	NOK	As of 11/10/2003
INDEPENDENT INTER-MARKET CURRENCIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
US Dollar Index Custom Continuous Futures Contract	DX	As of 09/23/2004
Australian Dollar Custom Continuous Futures Contract	AD	As of 05/02/2001
Canadian Dollar Custom Continuous Futures Contract	CD	As of 05/02/2001
South African Rand Custom Continuous Futures Contract	RA	As of 12/01/2004
INDEPENDENT INTER-MARKET COMMODITIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
S&P GSCI Commodity Index	GI	As of 08/16/2001
Gold Custom Continuous Contract	GC	As of 10/22/2002
INDEPENDENT INTER-MARKET BONDS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
30 Yr. US Treasury Bond Custom Continuous Futures Contract	US	As of 10/25/2002
10 Yr. US Treasury Note Custom Continuous Futures Contract	TY	As of 09/30/2002
Eurodollar Custom Continuous Futures Contract	ED	As of 09/27/1994

Source: The Author, 2013

5.2.5.2 The Data Sample Period

Test set: Intra-day 240-minute data from November 10, 2003 – December 31, 2012

Live set: Intra-day 240-minute data from January 1, 2013 – present

[11] *Source: www.norway.org*

5.2.5.3 The Trade Entry Rules

Breakout and price trend movements in the dependent traded market were identified by the standard Momentum (MOM) Indicator trading rule, resulting in the following long and short MOM based trade entry rules for the Norwegian Krone (NOK):

Buy: NOK MOM(t-1) < 0 and NOK MOM(t) > 0

If the Norwegian Krone Momentum crosses over the zero line from below, initiate a long position (buy) the dependent traded market Norwegian Krone.

Sell: NOK MOM(t-1) > 0 and NOK MOM(t) < 0

If the Norwegian Krone Momentum crosses under the zero line from above, initiate a short position (sell short) the dependent traded market Norwegian Krone.

5.2.5.4 Entry Rule Filters

Norwegian Krone intermarket correlations, volume confirmation and qualitative charting analysis were used to build trade entry rule filters to ensure that trades will only be entered into during those periods where Norwegian Krone price movement is supported by price trends in the independent intermarkets, high volume in the Norwegian Krone market and a supporting chart pattern or trendline breakout.

Intermarket Correlations:

Table 5-10: Intermarket Correlation Coefficients – Norwegian Krone (NOK)

	NOK	DX	AD	CD	RA	GI	GC	US	TY	ED
NOK	**1.00**									
DX	**-0.92**	1.00								
AD	**+0.84**	-0.94	1.00							
CD	**+0.88**	-0.93	+0.96*	1.00						
RA	**+0.42**	-0.66	+0.33	+0.46	1.00					
GI	**+0.88**	-0.89	+0.91	+0.95*	+0.48	1.00				
GC	**+0.67**	-0.88	+0.93	+0.92	+0.61	+0.92	1.00			
US	**+0.44**	-0.76	+0.72	+0.78	-0.19	+0.82	+0.91	1.00		
TY	**+0.39**	-0.70	+0.74	+0.70	-0.13	+0.75	+0.86	+0.96*	1.00	
ED	**+0.52**	-0.50	+0.58	+0.51	+0.14	+0.55	+0.71	+0.78	+0.89	1.00

Source: CSI Commodity Systems Inc.

As illustrated in Table 5-10, the intermarket correlations between the Norwegian Krone (NOK) and the US Dollar Index (DX), the Commodity Currencies (AD, CD and RA), Commodities (GI), Gold (GC), and US Treasury Bonds (US, TY and ED) were utilized to build trade entry rule filters whereby a Norwegian Krone long position was only initiated if it was supported by rising price momentum (MOM > 0) in the positively correlated independent intermarkets and falling price momentum (MOM < 0) in the negatively correlated independent intermarkets. Conversely, a Norwegian Krone short position was only initiated if it was supported by falling price momentum (MOM < 0) in the positively correlated independent intermarkets and rising price momentum (MOM > 0) in the negatively correlated independent intermarkets.

Volume:

A volume confirmation filter was utilized to ensure that Norwegian Krone long and short positions were only initiated when there was high volume in the Norwegian Krone market (NOK Volume Oscillator > 0) which suggests that there is enough market support to continue driving the Norwegian Krone price in the direction of the momentum trend.

Qualitative Charting:

Each individual Norwegian Krone trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Therefore,

Only initiate a Norwegian Krone (NOK) long position if:

The US Dollar Index (DX) MOM < 0

The Australian Dollar (AD) MOM > 0

The Canadian Dollar (CD) MOM > 0

The South African Rand (RA) MOM > 0

The Commodity Index (GI) MOM > 0

Gold (GC) MOM > 0

The 30 year US Treasury Bond (US) MOM > 0

The 10 year US Treasury Note (TY) MOM > 0

The Eurodollar (ED) MOM > 0

The Norwegian Krone Volume Oscillator (Volume Osc) > 0 and

Finally, each individual long trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Only initiate a Norwegian Krone short position if:

The US Dollar Index (DX) MOM > 0

The Australian Dollar (AD) MOM < 0

The Canadian Dollar (CD) MOM < 0

The South African Rand (RA) MOM < 0

The Commodity Index (GI) MOM < 0

Gold (GC) MOM < 0

The 30 year US Treasury Bond (US) MOM < 0

The 10 year US Treasury Note (TY) MOM < 0

The Eurodollar (ED) MOM < 0

The Norwegian Krone Volume Oscillator (Volume Osc) > 0 and

Finally, each individual short trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

5.2.5.5 Trade Exit Rules

The Norwegian Krone Momentum Indicator was used to signal trend reversals and the necessity to exit the trade position.

In a long Norwegian Krone (NOK) position:

If the Norwegian Krone (NOK) MOM crosses below the zero line, sell to close out the position.

In a short Norwegian Krone (NOK) position:

If the Norwegian Krone (NOK) MOM crosses above the zero line, buy to cover and close out the position.

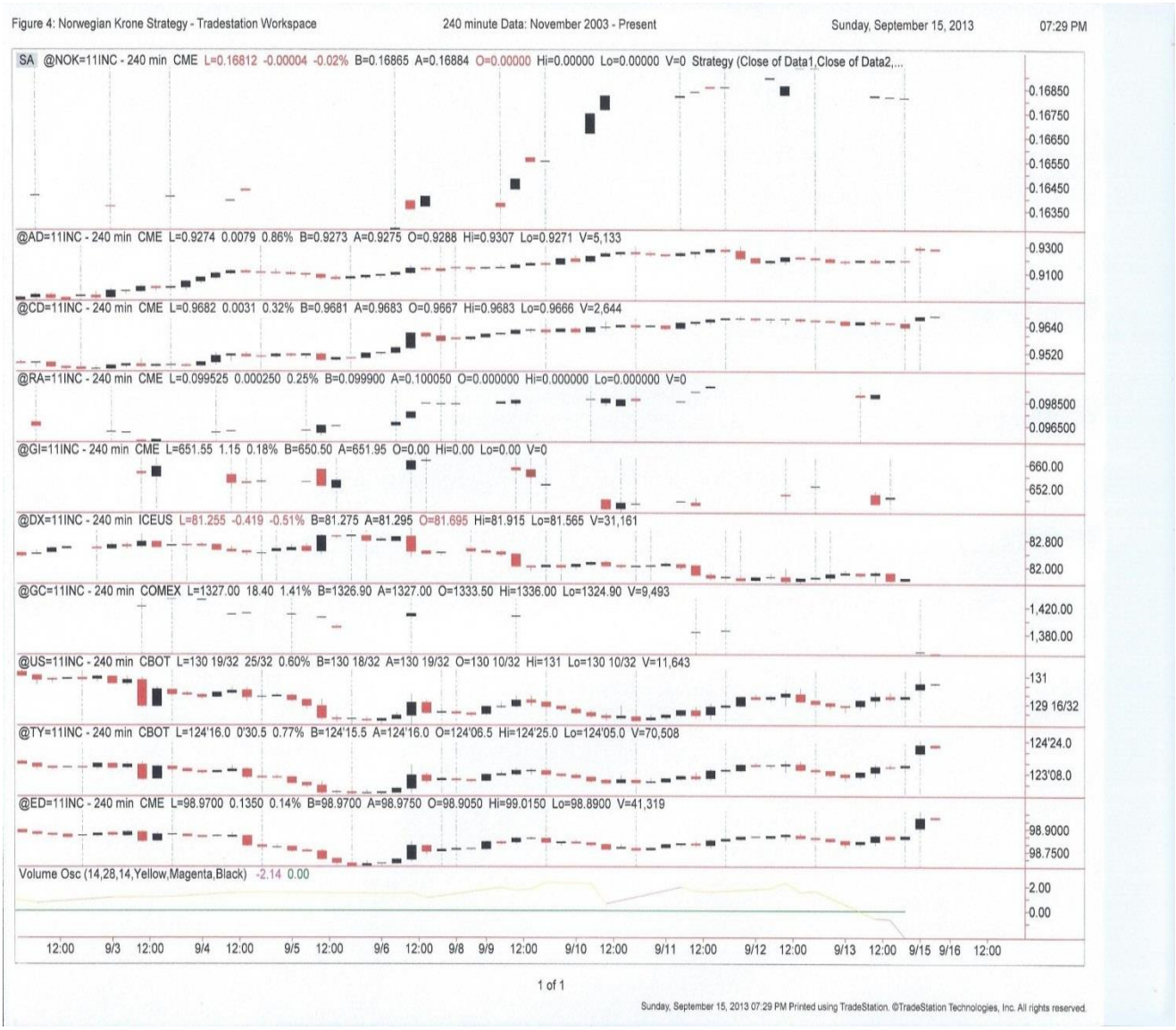
5.2.5.6 Setting Up the Norwegian Krone Strategy TradeStation Workspace

Intra-day 240-minute data charts of the Norwegian Krone (NOK), Australian Dollar (AD), Canadian Dollar (CD), the South African Rand (RA), the Commodity Index (GI), the US Dollar Index (DX), Gold (GC), the 30

year US Treasury Bond (US), the 10 year US Treasury Note (TY), and the Eurodollar (ED) for the period November 10, 2003 – Present were inserted into a TradeStation workspace.

A Norwegian Krone Volume Oscillator (Volume Osc) was applied in a sub-graph below the main chart, as illustrated by a snapshot of the TradeStation Workspace in Figure 5-4 below:

Figure 5-4: Norwegian Krone Strategy - TradeStation Workspace



Source: TradeStation, 2013

5.2.6 The Commodity Index Trading Strategy

Previously identified Commodity Currency Intermarket relationships were utilized to develop an Intermarket Momentum trading strategy for the S&P GSCI Commodity Index (GI) – a world production weighted broad based index of commodities.

5.2.6.1 The Trade Strategy Premise

The most important commodity intermarket is its relationship to the international reserve currency the US Dollar, which results in commodities being priced and traded in US Dollars worldwide. In periods of dollar weakness, commodity producers will raise prices to compensate for the eroded value of their dollar denominated commodity receipts. Conversely, in periods of dollar strength commodity prices will fall therefore in general one can expect that the US Dollar will exhibit a strong negative correlation with Commodity prices.

This also results in a strong negative relationship between the US Dollar and the price of Gold (GC), therefore it follows that the Commodity Index will be positively correlated to the Gold (GC) price which is further reinforced by the fact that Gold is an important component of the Commodity Index.

Additionally, fluctuations in commodity prices will have a direct valuation effect on the commodity currencies. A rise in commodity prices will increase demand for the commodity currencies from importing nations, resulting in an appreciation of the commodity currencies in the global foreign exchange markets. Consequently, a positive intermarket relationship is expected between the commodity index and the commodity currencies.

Ruggiero (1997) also identifies a positive relationship between US Treasury Bonds and the commodity currencies based on the inverse relationship between bond prices and yields and the resulting international capital flows. On the basis of the positive intermarket relationship between the commodity index and the commodity currencies, it may therefore be deduced that the commodity index will also exhibit a positive intermarket relationship to US Treasury Bonds.

The afore-mentioned negative intermarket correlation between the Commodity Index (GI) and the US Dollar (DX), and the positive intermarket correlations between the Commodity Index (GI) and Gold (GC), the commodity currencies - Australian Dollar (AD), Canadian Dollar (CD), South African Rand (RA) and Norwegian Krone (NOK) – 30 Year US Treasury Bonds (US), 10 Year US Treasury Notes (TY) and the Eurodollar (ED) were confirmed by the correlation lab software of CSI Commodity Systems Inc. as detailed over-page in Table 5-11:

Table 5-11: Correlation Coefficients - Commodity Index Intermarket Relationships

NO. OF YEARS BACK	MARKET	MARKET	CORRELATION COEFFICIENT
15 Years	GI	DX	-0.89
15 Years	GI	GC	+0.92
15 Years	GI	AD	+0.91
15 Years	GI	CD	+0.95
2 Years	GI	RA	+0.48
10 Years	GI	NOK	+0.88
15 Years	GI	US	+0.82
15 Years	GI	TY	+0.75
15 Years	GI	ED	+0.55

Source: CSI Commodity Systems Inc.

5.2.6.2 The Trade Data

The above identified intermarket relationships form the dependent traded market and independent intermarket data utilized in the development of an Intermarket Momentum trading strategy for the Commodity Index (GI) as detailed below in Table 5-12:

Table 5-12: Traded Market and Intermarket Data - Commodity Index Strategy

DEPENDENT TRADED MARKET	TRADESTATION SYMBOL	INTRA-DAY HISTORICAL DATA
S&P GSCI Commodity Index	GI	As of 08/16/2001
INDEPENDENT INTER-MARKET CURRENCIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
US Dollar Index Custom Continuous Futures Contract	DX	As of 09/23/2004
Australian Dollar Custom Continuous Futures Contract	AD	As of 05/02/2001
Canadian Dollar Custom Continuous Futures Contract	CD	As of 05/02/2001
South African Rand Custom Continuous Futures Contract	RA	As of 12/01/2004
Norwegian Krone Custom Continuous Futures Contract	NOK	As of 11/10/2003
INDEPENDENT INTER-MARKET COMMODITIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
Gold Custom Continuous Contract	GC	As of 10/22/2002
INDEPENDENT INTER-MARKET BONDS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
30 Yr. US Treasury Bond Custom Continuous Futures Contract	US	As of 10/25/2002
10 Yr. US Treasury Note Custom Continuous Futures Contract	TY	As of 09/30/2002
Eurodollar Custom Continuous Futures Contract	ED	As of 09/27/1994

Source: The Author, 2013

5.2.6.3 The Data Sample Period

Test set: Intra-day 240-minute data from August 16, 2001 – December 31, 2012

Live set: Intra-day 240-minute data from January 1, 2013 – present

5.2.6.4 The Trade Entry Rules

Breakout and price trend movements in the dependent traded market were identified by the standard Momentum (MOM) Indicator trading rule whereby a buy (sell) signal is triggered when the MOM crosses the zero line from below (above). Therefore, the following long and short MOM based trade entry rules were developed for the Commodity Index (GI):

Buy: GI MOM(t-1) < 0 and GI MOM(t) > 0

If the Commodity Index Momentum crosses over the zero line from below, initiate a long position (buy) the dependent traded market Commodity Index (GI).

Sell: GI MOM(t-1) > 0 and GI MOM(t) < 0

If the Commodity Index Momentum crosses under the zero line from above, initiate a short position (sell short) the dependent traded market Commodity Index (GI).

5.2.6.5 Entry Rule Filters

Commodity Index intermarket correlations, volume confirmation and qualitative charting analysis were used to build trade entry rule filters to ensure that trades will only be entered into during those periods where Commodity Index price movement is supported by price trends in the independent intermarkets, high volume in the Commodity Index market and a supporting chart pattern or trendline breakout.

Intermarket Correlations:

Table 5-13: Intermarket Correlation Coefficients – Commodity Index (GI)

	GI	DX	AD	CD	RA	NOK	GC	US	TY	ED
GI	**1.00**									
DX	**-0.89**	1.00								
AD	**+0.91**	-0.94	1.00							
CD	**+0.95***	-0.93	+0.96*	1.00						
RA	**+0.48**	-0.66	+0.33	+0.46	1.00					
NOK	**+0.88**	-0.92	+0.84	+0.88	+0.42	1.00				
GC	**+0.92**	-0.88	+0.93	+0.92	+0.61	+0.67	1.00			
US	**+0.82**	-0.76	+0.72	+0.78	-0.19	+0.44	+0.91	1.00		
TY	**+0.75**	-0.70	+0.74	+0.70	-0.13	+0.39	+0.86	+0.96*	1.00	
ED	**+0.55**	-0.50	+0.58	+0.51	+0.14	+0.52	+0.71	+0.78	+0.89	1.00

Source: CSI Commodity Systems Inc.

As illustrated in Table 5-13, the intermarket correlations between the Commodity Index (GI) and the US Dollar Index (DX), the Commodity Currencies (AD, CD, RA and NOK), Gold (GC), and US Treasury Bonds (US, TY and ED) were utilized to build trade entry rule filters whereby a Commodity Index long position was only initiated if it was supported by rising price momentum (MOM > 0) in the positively correlated independent intermarkets and falling price momentum (MOM < 0) in the negatively correlated independent intermarkets. Conversely, a Commodity Index short position was only initiated if it was supported by falling price momentum (MOM < 0) in the positively correlated independent intermarkets and rising price momentum (MOM > 0) in the negatively correlated independent intermarkets.

Volume:

A volume confirmation filter was utilized to ensure that Commodity Index long and short positions were only initiated when there was high volume in the Commodity Index market (GI Volume Oscillator > 0) which suggests that there is enough market support to continue driving the Commodity Index price in the direction of the momentum trend.

Qualitative Charting:

Each individual Commodity Index trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Therefore,

Only initiate a Commodity Index (GI) long position if:

The US Dollar Index (DX) MOM < 0

The Australian Dollar (AD) MOM > 0

The Canadian Dollar (CD) MOM > 0

The South African Rand (RA) MOM > 0

The Norwegian Krone (NOK) MOM > 0

Gold (GC) MOM > 0

The 30 year US Treasury Bond (US) MOM > 0

The 10 year US Treasury Note (TY) MOM > 0

The Eurodollar (ED) MOM > 0

The Commodity Index (GI) Volume Oscillator (Volume Osc) > 0 and

Finally, each individual long trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Only initiate a Commodity Index (GI) short position if:

The US Dollar Index (DX) MOM > 0

The Australian Dollar (AD) MOM < 0

The Canadian Dollar (CD) MOM < 0

The South African Rand (RA) MOM < 0

The Norwegian Krone (NOK) MOM < 0

Gold (GC) MOM < 0

The 30 year US Treasury Bond (US) MOM < 0

The 10 year US Treasury Note (TY) MOM < 0

The Eurodollar (ED) MOM < 0

The Commodity Index (GI) Volume Oscillator (Volume Osc) > 0 and

Finally, each individual short trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

5.2.6.6 Trade Exit Rules

The Commodity Index (GI) Momentum Indicator was used to signal trend reversals and the necessity to exit the trade position.

In a long Commodity Index (GI) position:

If the Commodity Index (GI) MOM crosses below the zero line, sell to close out the position.

In a short Commodity Index (GI) position:

If the Commodity Index (GI) MOM crosses above the zero line, buy to cover and close out the position.

5.2.6.7 Setting Up the Commodity Index Strategy TradeStation Workspace

Intra-day 240-minute data charts of the Commodity Index (GI), Australian Dollar (AD), Canadian Dollar (CD), the South African Rand (RA), Norwegian Krone (NOK), the US Dollar Index (DX), Gold (GC), the 30

year US Treasury Bond (US), the 10 year US Treasury Note (TY), and the Eurodollar (ED) for the period August 16, 2001 – Present were inserted into a TradeStation workspace.

A Commodity Index (GI) Volume Oscillator (Volume Osc) was applied in a sub-graph below the main chart, as illustrated by a snapshot of the TradeStation Workspace in Figure 5-5 below:

Figure 5-5: Commodity Index Strategy - TradeStation Workspace

Source: TradeStation, 2013

5.2.7 Trading the Precious Metals

Intermarket relationships as identified by Ruggiero (1997) were utilized to develop intermarket momentum trading strategies for the Precious Metals – Gold (GC), Silver (SI) and Platinum (PL).

5.2.7.1 The Trade Strategy Premise

Ruggiero (1997: 21) illustrates with the aid of graphs the intermarket relationship that clearly shows the Gold price being negatively correlated with the US Dollar due to the previously described international reserve currency characteristic of the US Dollar.

It follows that Gold will also therefore be positively correlated to Commodities. This can also be elucidated by the fact that Commodities form the basic inputs that fuel the engine of an economy, therefore a rise in commodity prices will generally flow through the production chain and result in increased producer and consumer prices. Heightened inflationary expectations increase the demand for the store of value inflation hedge characteristic of gold. This chain of events initiated by a rise in Commodity prices results in an appreciating gold price reinforcing the positive relationship between the Gold price and Commodities.

It was previously shown how a positive relationship between Commodities and US Treasury Bonds may be deduced from the positive correlation between the Commodity Currencies and US Treasury Bonds. Therefore, one can further deduce an expected positive correlation between Gold and US Treasury Bonds which can also be clarified by the link between rising bond prices and the store of value inflation hedge characteristic of Gold. As bond prices rise, bond yields and interest rates fall – in a low interest rate environment, companies prosper thus raising future inflation expectations which consequently stimulate the demand for Gold as an inflation hedge.

The nature of Gold mining stocks to predict and lead the Gold price at major turning points was explained by Ruggiero (1997) as arising from the fact that Gold stocks are highly leveraged to the price of Gold. For example, a 9% rise in the Gold price from $ 1100 to $ 1200 per ounce will result in a 100% increase in the profit of a Gold mining company with a production cost of $ 1000. This predictive positive correlation was confirmed by charts depicting the price of Gold versus the Philadelphia Gold and Silver Index (XAU) - a capitalization weighted index of the 16 leading precious metal mining companies involved in the mining and production of gold and silver (Ruggiero, 1997: 24).

Finally, Ruggiero (1997: 23) illustrates the close correlation between the Precious Metals – Gold, Silver and Platinum, with Silver and Platinum leading and being predictive of Gold at major turning points. This correlation is due to the fact that apart from their industrial usage, the Precious Metals - Gold, Silver and Platinum, more importantly all derive value due to their function as hedges against inflation and a store of value. Their market prices therefore not surprisingly move together very closely, and the above noted intermarket relationships for Gold will also therefore apply to Silver and Platinum.

The afore-mentioned negative intermarket correlation between Gold (GC) and the US Dollar (DX); and the positive intermarket correlations between Gold (GC) and Commodities (GI), 30 Year US Treasury Bonds (US), 10 Year US Treasury Notes (TY), Eurodollar (ED), Philadelphia Gold and Silver Index (XAU) and the Precious Metals – Silver (SI) and Platinum (PL) were confirmed by the correlation lab software of CSI Commodity Systems Inc. as detailed below in Table 5-14:

Table 5-14: Correlation Coefficients - Precious Metals Intermarket Relationships

NO. OF YEARS BACK	MARKET	MARKET	CORRELATION COEFFICIENT
15 Years	GC	DX	-0.88
15 Years	GC	GI	+0.92
15 Years	GC	US	+0.91
15 Years	GC	TY	+0.86
15 Years	GC	ED	+0.71
15 Years	GC	XAU	+0.92
15 Years	GC	SI	+0.95
15 Years	GC	PL	+0.93
15 Years	SI	DX	-0.90
15 Years	SI	GI	+0.91
15 Years	SI	US	+0.81
15 Years	SI	TY	+0.73
15 Years	SI	ED	+0.56
15 Years	SI	XAU	+0.92
15 Years	SI	PL	+0.91
15 Years	PL	DX	-0.89
15 Years	PL	GI	+0.97
15 Years	PL	US	+0.82
15 Years	PL	TY	+0.76
15 Years	PL	ED	+0.60
15 Years	PL	XAU	0.93

Source: CSI Commodity Systems Inc.

5.2.8 The Gold Strategy

5.2.8.1 The Trade Data

The above identified Precious Metal intermarket relationships form the dependent traded market and independent inter-market data utilized in the development of an Intermarket Momentum trading strategy for Gold.

The trade data are detailed below in Table 5-15:

Table 5-15: Traded Market and Intermarket Data - Gold Strategy

DEPENDENT TRADED MARKET	TRADESTATION SYMBOL	INTRA-DAY HISTORICAL DATA
Gold Custom Continuous Contract	GC	As of 10/22/2002
INDEPENDENT INTER-MARKET CURRENCIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
US Dollar Index Custom Continuous Futures Contract	DX	As of 09/23/2004
INDEPENDENT INTER-MARKET COMMODITIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
S&P GSCI Commodity Index	GI	As of 08/16/2001
Silver Custom Continuous Contract	SI	As of 09/20/2001
Platinum Custom Continuous Contract	PL	As of 09/14/2001
INDEPENDENT INTER-MARKET BONDS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
30 Yr. US Treasury Bond Custom Continuous Futures Contract	US	As of 10/25/2002
10 Yr. US Treasury Note Custom Continuous Futures Contract	TY	As of 09/30/2002
Eurodollar Custom Continuous Futures Contract	ED	As of 09/27/1994
INDEPENDENT INTER-MARKET STOCKS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
Philadelphia Gold and Silver Index	XAU	As of 01/08/2001

Source: The Author, 2013

5.2.8.2 The Data Sample Period

Test set: Intra-day 240-minute data from October 22, 2002 – December 31, 2012

Live set: Intra-day 240-minute data from January 1, 2013 – present

5.2.8.3 The Trade Entry Rules

Breakout and price trend movements in the dependent traded market were identified by the standard Momentum (MOM) Indicator trading rule whereby a buy (sell) signal is triggered when the MOM crosses the zero line from below (above). Therefore, the following long and short MOM based trade entry rules were developed for Gold (GC):

Buy: GC MOM(t-1) < 0 and GC MOM(t) > 0

If the Gold Momentum crosses over the zero line from below, initiate a long position (buy) the dependent traded market Gold (GC).

Sell: GC MOM(t-1) > 0 and GC MOM(t) < 0

If the Gold Momentum crosses under the zero line from above, initiate a short position (sell short) the dependent traded market Gold (GC).

5.2.8.4 Entry Rule Filters

Gold intermarket correlations, volume confirmation and qualitative charting analysis were used to build trade entry rule filters to ensure that trades will only be entered into during those periods where Gold price movement is supported by price trends in the independent intermarkets, high volume in the Gold market and a supporting chart pattern or trendline breakout.

Intermarket Correlations:

Table 5-16: Intermarket Correlation Coefficients – Gold (GC)

	GC	SI	PL	GI	XAU	DX	US	TY	ED
GC	**1.00**								
SI	**+0.95***	1.00							
PL	**+0.93**	+0.91	1.00						
GI	**+0.92**	+0.91	+0.97*	1.00					
XAU	**+0.92**	+0.92	+0.93	+0.89	1.00				
DX	**-0.88**	-0.90	-0.89	-0.89	-0.92	1.00			
US	**+0.91**	+0.81	+0.82	+0.82	+0.78	-0.76	1.00		
TY	**+0.86**	+0.73	+0.76	+0.75	+0.72	-0.70	+0.96*	1.00	
ED	**+0.71**	+0.56	+0.60	+0.55	+0.56	-0.50	+0.78	+0.89	1.00

Source: CSI Commodity Systems Inc.

As illustrated in Table 5-16, the intermarket correlations between Gold (GC) and Silver (SI), Platinum (PL), Commodities (GI), the Philadelphia Gold and Silver Index (XAU), the US Dollar Index (DX), and US Treasury Bonds (US, TY and ED) were utilized to build trade entry rule filters whereby a Gold long position was only initiated if it was supported by rising price momentum (MOM > 0) in the positively correlated independent intermarkets and falling price momentum (MOM < 0) in the negatively correlated independent intermarkets. Conversely, a Gold short position was only initiated if it was supported by falling price momentum (MOM < 0) in the positively correlated independent intermarkets and rising price momentum (MOM > 0) in the negatively correlated independent intermarkets.

Volume:

A volume confirmation filter was utilized to ensure that Gold long and short positions were only initiated when there was high volume in the Gold market (GC Volume Oscillator > 0) which suggests that there is enough market support to continue driving the Gold price in the direction of the momentum trend.

Qualitative Charting:

Each individual Gold trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Therefore,

Only initiate a Gold (GC) long position if:

Silver (SI) MOM > 0

Platinum (PL) MOM > 0

The Commodity Index (GI) MOM > 0

The Philadelphia Gold and Silver Index (XAU) MOM > 0

The US Dollar Index (DX) MOM < 0

The 30 year US Treasury Bond (US) MOM > 0

The 10 year US Treasury Note (TY) MOM > 0

The Eurodollar (ED) MOM > 0

The Gold (GC) Volume Oscillator (Volume Osc) > 0 and

Finally, each individual long trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Only initiate a Gold (GC) short position if:

Silver (SI) MOM < 0

Platinum (PL) MOM < 0

The Commodity Index (GI) MOM < 0

The Philadelphia Gold and Silver Index (XAU) MOM < 0

The US Dollar Index (DX) MOM > 0

The 30 year US Treasury Bond (US) MOM < 0

The 10 year US Treasury Note (TY) MOM < 0

The Eurodollar (ED) MOM < 0

The Gold (GC) Volume Oscillator (Volume Osc) > 0 and

Finally, each individual short trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

5.2.8.5 Trade Exit Rules

The Gold (GC) Momentum Indicator was used to signal trend reversals and the necessity to exit the trade position.

In a long Gold (GC) position:

If the Gold (GC) MOM crosses below the zero line, sell to close out the position.

In a short Gold (GC) position:

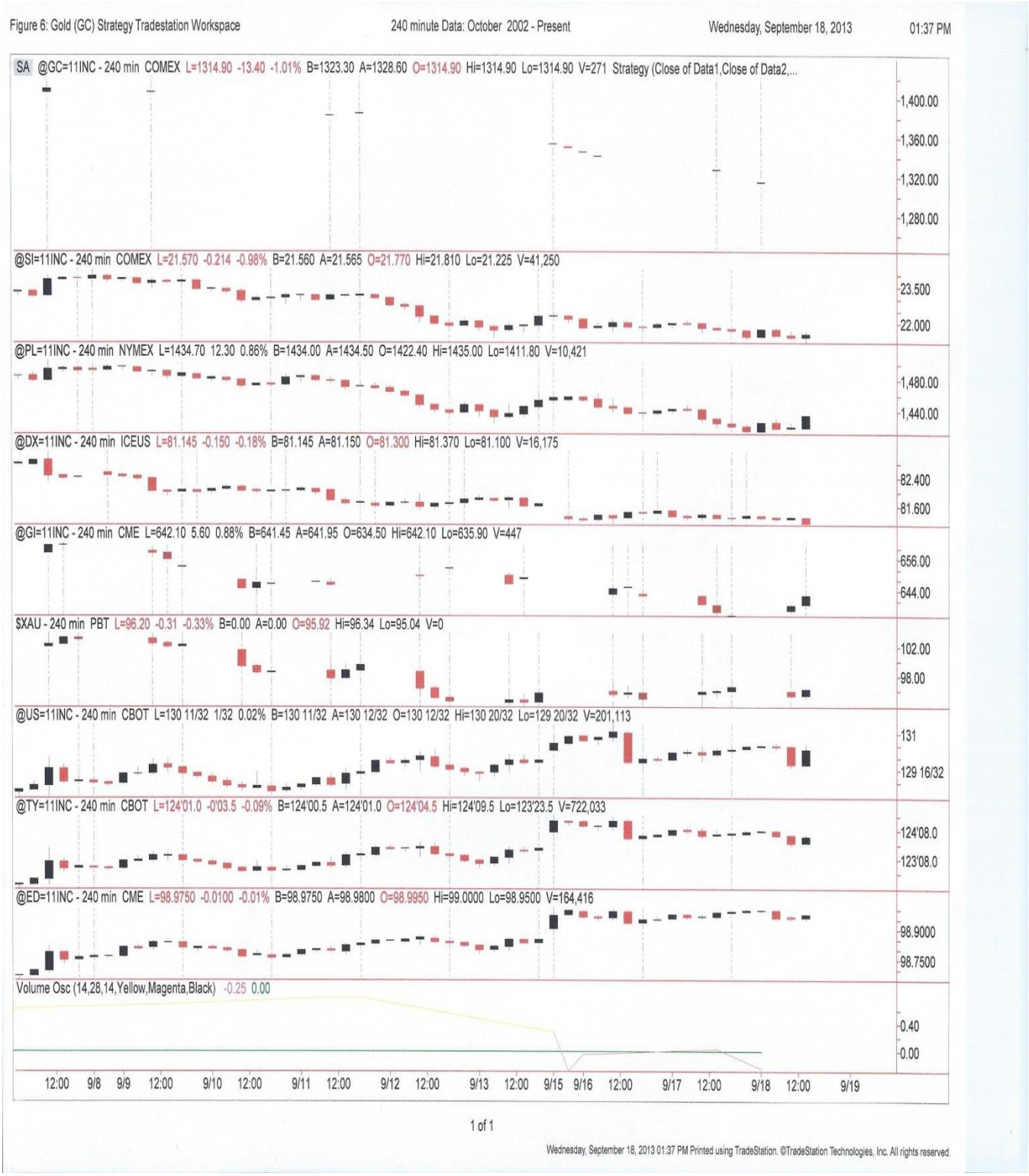
If the Gold (GC) MOM crosses above the zero line, buy to cover and close out the position.

5.2.8.6 Setting Up the Gold Strategy TradeStation Workspace

Intra-day 240-minute data charts of Gold (GC), Silver (SI), Platinum (PL), the US Dollar Index (DX), the Commodity Index (GI), the Philadelphia Gold and Silver Index (XAU), the 30 year US Treasury Bond (US), the 10 year US Treasury Note (TY), and the Eurodollar (ED) for the period October 22, 2002 – Present were inserted into a TradeStation workspace.

A Gold (GC) Volume Oscillator (Volume Osc) was applied in a sub-graph below the main chart, as illustrated by a snapshot of the TradeStation Workspace in Figure 5-6 over-page:

Figure 5-6: Gold Strategy - TradeStation Workspace



Source: TradeStation, 2013

5.2.9 The Silver Strategy

5.2.9.1 The Trade Data

The above identified Precious Metal intermarket relationships form the dependent traded market and independent inter-market data utilized in the development of an Intermarket Momentum trading strategy for Silver.

The trade data are detailed below in Table 5-17:

Table 5-17: Traded Market and Intermarket Data - Silver Strategy

DEPENDENT TRADED MARKET	TRADESTATION SYMBOL	INTRA-DAY HISTORICAL DATA
Silver Custom Continuous Contract	SI	As of 09/20/2001
INDEPENDENT INTER-MARKET CURRENCIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
US Dollar Index Custom Continuous Futures Contract	DX	As of 09/23/2004
INDEPENDENT INTER-MARKET COMMODITIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
S&P GSCI Commodity Index	GI	As of 08/16/2001
Gold Custom Continuous Contract	GC	As of 10/22/2002
Platinum Custom Continuous Contract	PL	As of 09/14/2001
INDEPENDENT INTER-MARKET BONDS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
30 Yr. US Treasury Bond Custom Continuous Futures Contract	US	As of 10/25/2002
10 Yr. US Treasury Note Custom Continuous Futures Contract	TY	As of 09/30/2002
Eurodollar Custom Continuous Futures Contract	ED	As of 09/27/1994
INDEPENDENT INTER-MARKET STOCKS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
Philadelphia Gold and Silver Index	XAU	As of 01/08/2001

Source: The Author, 2013

5.2.9.2 The Data Sample Period

Test set: Intra-day 240-minute data from September 20, 2001 – December 31, 2012

Live set: Intra-day 240-minute data from January 1, 2013 – present

5.2.9.3 The Trade Entry Rules

Breakout and price trend movements in the dependent traded market were identified by the standard Momentum (MOM) Indicator trading rule whereby a buy (sell) signal is triggered when the MOM crosses the zero line from below (above). Therefore, the following long and short MOM based trade entry rules were developed for Silver (SI):

Buy: SI MOM(t-1) < 0 and SI MOM(t) > 0

If the Silver Momentum crosses over the zero line from below, initiate a long position (buy) the dependent traded market Silver (SI).

Sell: SI MOM(t-1) > 0 and SI MOM(t) < 0

If the Silver Momentum crosses under the zero line from above, initiate a short position (sell short) the dependent traded market Silver (SI).

5.2.9.4 Entry Rule Filters

Silver intermarket correlations, volume confirmation and qualitative charting analysis were used to build trade entry rule filters to ensure that trades will only be entered into during those periods where Silver price movement is supported by price trends in the independent inter-markets, high volume in the Silver market and a supporting chart pattern or trendline breakout.

Intermarket Correlations:

Table 5-18: Intermarket Correlation Coefficients – Silver (SI)

	SI	GC	PL	GI	XAU	DX	US	TY	ED
SI	**1.00**								
GC	**+0.95***	1.00							
PL	**+0.91**	+0.93	1.00						
GI	**+0.91**	+0.92	+0.97*	1.00					
XAU	**+0.92**	+0.92	+0.93	+0.89	1.00				
DX	**-0.90**	-0.88	-0.89	-0.89	-0.92	1.00			
US	**+0.81**	+0.91	+0.82	+0.82	+0.78	-0.76	1.00		
TY	**+0.73**	+0.86	+0.76	+0.75	+0.72	-0.70	+0.96*	1.00	
ED	**+0.56**	+0.71	+0.60	+0.55	+0.56	-0.50	+0.78	+0.89	1.00

Source: CSI Commodity Systems Inc.

As illustrated in Table 5-18, the intermarket correlations between Silver (SI), and Gold (GC), Platinum (PL), Commodities (GI), the Philadelphia Gold and Silver Index (XAU), the US Dollar Index (DX), and US Treasury Bonds (US, TY and ED) were utilized to build trade entry rule filters whereby a Silver long position was only initiated if it was supported by rising price momentum (MOM > 0) in the positively correlated independent intermarkets and falling price momentum (MOM < 0) in the negatively correlated independent intermarkets. Conversely, a Silver short position was only initiated if it was supported by falling price momentum (MOM < 0) in the positively correlated independent intermarkets and rising price momentum (MOM > 0) in the negatively correlated independent intermarkets.

Volume:

A volume confirmation filter was utilized to ensure that Silver long and short positions were only initiated when there was high volume in the Silver market (SI Volume Oscillator > 0) which suggests that there is enough market support to continue driving the Silver price in the direction of the momentum trend.

Qualitative Charting:

Each individual Silver trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Therefore,

Only initiate a Silver (SI) long position if:

Gold (GC) MOM > 0

Platinum (PL) MOM > 0

The Commodity Index (GI) MOM > 0

The Philadelphia Gold and Silver Index (XAU) MOM > 0

The US Dollar Index (DX) MOM < 0

The 30 year US Treasury Bond (US) MOM > 0

The 10 year US Treasury Note (TY) MOM > 0

The Eurodollar (ED) MOM > 0

The Silver (SI) Volume Oscillator (Volume Osc) > 0 and

Finally, each individual long trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Only initiate a Silver (SI) short position if:

Gold (GC) MOM < 0

Platinum (PL) MOM < 0

The Commodity Index (GI) MOM < 0

The Philadelphia Gold and Silver Index (XAU) MOM < 0

The US Dollar Index (DX) MOM > 0

The 30 year US Treasury Bond (US) MOM < 0

The 10 year US Treasury Note (TY) MOM < 0

The Eurodollar (ED) MOM < 0

The Silver (SI) Volume Oscillator (Volume Osc) > 0 and

Finally, each individual short trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

5.2.9.5 Trade Exit Rules

The Silver (SI) Momentum Indicator was used to signal trend reversals and the necessity to exit the trade position.

In a long Silver (SI) position:

If the Silver (SI) MOM crosses below the zero line, sell to close out the position.

In a short Silver (SI) position:

If the Silver (SI) MOM crosses above the zero line, buy to cover and close out the position.

5.2.9.6 Setting Up the Silver Strategy TradeStation Workspace

Intra-day 240-minute data charts of Silver (SI), Gold (GC), Platinum (PL), the US Dollar Index (DX), the Commodity Index (GI), the Philadelphia Gold and Silver Index (XAU), the 30 year US Treasury Bond (US), the 10 year US Treasury Note (TY), and the Eurodollar (ED) for the period September 20, 2001 – Present were inserted into a TradeStation workspace.

A Silver (SI) Volume Oscillator (Volume Osc) was applied in a sub-graph below the main chart, as illustrated by a snapshot of the TradeStation Workspace in Figure 5-7 over-page. The Precious Metal intermarket

linkages were also clearly depicted and confirmed in Figure 5-7 by the break-out 240 minute candlesticks that occurred at 2pm on Wednesday September 18, 2013 upon the surprise announcement by Federal Reserve Chairman Ben Bernanke that contrary to all expectations, the Quantitative Easing (QE) program would continue unabated and that there would be no taper. The continued Treasury Bond purchases (QE) by the Federal Reserve raises the demand for bonds and drives up their price (see the positive US, TY and ED candlesticks). Rising bond prices result in falling bond yields and interest rates, reducing the demand for dollar based assets and consequently driving down the Dollar Index (see negative DX candlestick). A depreciating Dollar pushes up Commodity prices (see positive GI, XAU, GC, SI and Pl candlesticks), and additionally the low interest rate environment spawned by the rising bond prices heightens inflation expectations and increases the demand for the inflation hedge characteristic of the Precious Metals (see positive GC, SI and PL candlesticks).

Figure 5-7: Silver Strategy - TradeStation Workspace

Source: TradeStation, 2013

5.2.10 The Platinum Strategy

5.2.10.1 The Trade Data

The above identified Precious Metal intermarket relationships form the dependent traded market and independent inter-market data utilized in the development of an Intermarket Momentum trading strategy for Platinum.

The trade data are detailed below in Table 5-19:

Table 5-19: Traded Market and Intermarket Data - Platinum Strategy

DEPENDENT TRADED MARKET	TRADESTATION SYMBOL	INTRA-DAY HISTORICAL DATA
Platinum Custom Continuous Contract	PL	As of 09/14/2001
INDEPENDENT INTER-MARKET CURRENCIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
US Dollar Index Custom Continuous Futures Contract	DX	As of 09/23/2004
INDEPENDENT INTER-MARKET COMMODITIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
S&P GSCI Commodity Index	GI	As of 08/16/2001
Silver Custom Continuous Contract	SI	As of 09/20/2001
Gold Custom Continuous Contract	GC	As of 10/22/2002
INDEPENDENT INTER-MARKET BONDS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
30 Yr. US Treasury Bond Custom Continuous Futures Contract	US	As of 10/25/2002
10 Yr. US Treasury Note Custom Continuous Futures Contract	TY	As of 09/30/2002
Eurodollar Custom Continuous Futures Contract	ED	As of 09/27/1994
INDEPENDENT INTER-MARKET STOCKS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
Philadelphia Gold and Silver Index	XAU	As of 01/08/2001

Source: The Author, 2013

5.2.10.2 The Data Sample Period

Test set: Intra-day 240-minute data from September 14, 2001 – December 31, 2012

Live set: Intra-day 240-minute data from January 1, 2013 – present

5.2.10.3 The Trade Entry Rules

Breakout and price trend movements in the dependent traded market were identified by the standard Momentum (MOM) Indicator trading rule whereby a buy (sell) signal is triggered when the MOM crosses the zero line from below (above). Therefore, the following long and short MOM based trade entry rules were developed for Platinum (PL):

Buy: PL MOM(t-1) < 0 and PL MOM(t) > 0

If the Platinum Momentum crosses over the zero line from below, initiate a long position (buy) the dependent traded market Platinum (PL).

Sell: PL MOM(t-1) > 0 and PL MOM(t) < 0

If the Platinum Momentum crosses under the zero line from above, initiate a short position (sell short) the dependent traded market Platinum (PL).

5.2.10.4 Entry Rule Filters

Platinum intermarket correlations, volume confirmation and qualitative charting analysis were used to build trade entry rule filters to ensure that trades will only be entered into during those periods where Platinum price movement is supported by price trends in the independent inter-markets, high volume in the Platinum market and a supporting chart pattern or trendline breakout.

Intermarket Correlations:

Table 5-20: Intermarket Correlation Coefficients – Platinum (PL)

	PL	GC	SI	GI	XAU	DX	US	TY	ED
PL	**1.00**								
GC	**+0.93**	1.00							
SI	**+0.91**	+0.95*	1.00						
GI	**+0.97***	+0.92	+0.91	1.00					
XAU	**+0.93**	+0.92	+0.92	+0.89	1.00				
DX	**-0.89**	-0.88	-0.90	-0.89	-0.92	1.00			
US	**+0.82**	+0.91	+0.81	+0.82	+0.78	-0.76	1.00		
TY	**+0.76**	+0.86	+0.73	+0.75	+0.72	-0.70	+0.96*	1.00	
ED	**+0.60**	+0.71	+0.56	+0.55	+0.56	-0.50	+0.78	+0.89	1.00

Source: CSI Commodity Systems Inc.

As illustrated in Table 5-20, the intermarket correlations between Platinum (PL) and Gold (GC), Silver (SI), Commodities (GI), the Philadelphia Gold and Silver Index (XAU), the US Dollar Index (DX), and US Treasury Bonds (US, TY and ED) were utilized to build trade entry rule filters whereby a Platinum long position was only initiated if it was supported by rising price momentum (MOM > 0) in the positively correlated independent intermarkets and falling price momentum (MOM < 0) in the negatively correlated independent intermarkets. Conversely, a Platinum short position was only initiated if it was supported by falling price momentum (MOM < 0) in the positively correlated independent intermarkets and rising price momentum (MOM > 0) in the negatively correlated independent intermarkets.

Volume:

A volume confirmation filter was utilized to ensure that Platinum long and short positions were only initiated when there was high volume in the Platinum market (PL Volume Oscillator > 0) which suggests that there is enough market support to continue driving the Platinum price in the direction of the momentum trend.

Qualitative Charting:

Each individual Platinum trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Therefore,

Only initiate a Platinum (PL) long position if:

Gold (GC) MOM > 0

Silver (SI) MOM > 0

The Commodity Index (GI) MOM > 0

The Philadelphia Gold and Silver Index (XAU) MOM > 0

The US Dollar Index (DX) MOM < 0

The 30 year US Treasury Bond (US) MOM > 0

The 10 year US Treasury Note (TY) MOM > 0

The Eurodollar (ED) MOM > 0

The Platinum (PL) Volume Oscillator (Volume Osc) > 0 and

Finally, each individual long trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Only initiate a Platinum (PL) short position if:

Gold (GC) MOM < 0

Silver (SI) MOM < 0

The Commodity Index (GI) MOM < 0

The Philadelphia Gold and Silver Index (XAU) MOM < 0

The US Dollar Index (DX) MOM > 0

The 30 year US Treasury Bond (US) MOM < 0

The 10 year US Treasury Note (TY) MOM < 0

The Eurodollar (ED) MOM < 0

The Platinum (PL) Volume Oscillator (Volume Osc) > 0 and

Finally, each individual short trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

5.2.10.5 Trade Exit Rules

The Platinum (PL) Momentum Indicator was used to signal trend reversals and the necessity to exit the trade position.

In a long Platinum (PL) position:

If the Platinum (PL) MOM crosses below the zero line, sell to close out the position.

In a short Platinum (PL) position:

If the Platinum (PL) MOM crosses above the zero line, buy to cover and close out the position.

5.2.10.6 Setting Up the Platinum Strategy TradeStation Workspace

Intra-day 240-minute data charts of Platinum (PL), Gold (GC), Silver (SI), the US Dollar Index (DX), the Commodity Index (GI), the Philadelphia Gold and Silver Index (XAU), the 30 year US Treasury Bond (US), the 10 year US Treasury Note (TY), and the Eurodollar (ED) for the period September 14, 2001 – Present were inserted into a TradeStation workspace.

A Platinum (PL) Volume Oscillator (Volume Osc) was applied in a sub-graph below the main chart, as illustrated by a snapshot of the TradeStation Workspace in Figure 5-8 over-page.

Figure 5-8: Platinum Strategy - TradeStation Workspace

Source: TradeStation, 2013

5.2.11 The Crude Oil Trading Strategy

Previously identified Commodity Currency and Commodity Intermarket relationships were utilized to develop an Intermarket Momentum trading strategy for Crude Oil (CL).

5.2.11.1 The Trade Strategy Premise

As the most important constituent of the energy commodity universe, Crude Oil is expected to be positively correlated to the Commodity Index (GI) and the Commodity Currencies, and negatively correlated to the international reserve currency in which commodities are priced and traded, the US Dollar.

In accordance with the positive relationship between the Commodity Currencies and Bonds, Crude Oil therefore is also expected to exhibit a positive correlation to the 30 Year US Treasury Bond, 10 Year US Treasury Note and the Eurodollar.

As in the case of Gold, Oil stocks are leveraged to the price of Crude Oil therefore the Amex Oil Stock Index (XOI) - a price weighted index of the leading companies involved in the exploration and production of Oil - leads the Crude Oil price at major turning points. This predictive positive correlation between Crude Oil (CL) and Oil Stocks (XOI) was illustrated by Ruggiero (1997: 26) using charts depicting the price of Crude Oil versus the XOI.

The afore-mentioned Crude Oil intermarket correlations were confirmed by the correlation lab software of CSI Commodity Systems Inc. as detailed below in Table 5-21. Not surprisingly, the Crude Oil (CL) / South African Rand (RA) positive correlation was relatively weak (+0.23) in comparison to the other Commodity Currencies due to the paucity of Oil reserves in South Africa.

Table 5-21: Correlation Coefficients - Crude Oil Intermarket Relationships

NO. OF YEARS BACK	MARKET	MARKET	CORRELATION COEFFICIENT
15 Years	CL	DX	-0.88
15 Years	CL	GI	+0.99
15 Years	CL	AD	+0.90
15 Years	CL	CD	+0.94
5 Years	CL	RA	+0.23
10 Years	CL	NOK	+0.86
15 Years	CL	XOI	+0.92
15 Years	CL	US	+0.81
15 Years	CL	TY	+0.74
15 Years	CL	ED	+0.55

Source: CSI Commodity Systems Inc.

5.2.11.2 The Trade Data

The above identified intermarket relationships form the dependent traded market and independent inter-market data utilized in the development of an Intermarket Momentum trading strategy for Crude Oil (CL) as detailed below in Table 5-22:

Table 5-22: Traded Market and Intermarket Data - Crude Oil Strategy

DEPENDENT TRADED MARKET	TRADESTATION SYMBOL	INTRA-DAY HISTORICAL DATA
Crude Oil Custom Continuous Contract	CL	As of 04/26/2002
INDEPENDENT INTER-MARKET CURRENCIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
US Dollar Index Custom Continuous Futures Contract	DX	As of 09/23/2004
Australian Dollar Custom Continuous Futures Contract	AD	As of 05/02/2001
Canadian Dollar Custom Continuous Futures Contract	CD	As of 05/02/2001
South African Rand Custom Continuous Futures Contract	RA	As of 12/01/2004
Norwegian Krone Custom Continuous Futures Contract	NOK	As of 11/10/2003
INDEPENDENT INTER-MARKET COMMODITIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
S&P GSCI Commodity Index	GI	As of 08/16/2001
INDEPENDENT INTER-MARKET BONDS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
30 Yr. US Treasury Bond Custom Continuous Futures Contract	US	As of 10/25/2002
10 Yr. US Treasury Note Custom Continuous Futures Contract	TY	As of 09/30/2002
Eurodollar Custom Continuous Futures Contract	ED	As of 09/27/1994
INDEPENDENT INTER-MARKET STOCKS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
Amex Oil Index	XOI	As of 01/18/2001

Source: The Author, 2013

5.2.11.3 The Data Sample Period

Test set: Intra-day 240-minute data from April 26, 2002 – December 31, 2012

Live set: Intra-day 240-minute data from January 1, 2013 – present

5.2.11.4 The Trade Entry Rules

Breakout and price trend movements in the dependent traded market were identified by the standard Momentum (MOM) Indicator trading rule whereby a buy (sell) signal is triggered when the MOM crosses the zero line from below (above). Therefore, the following long and short MOM based trade entry rules were developed for Crude Oil (CL):

Buy: CL MOM(t-1) < 0 and CL MOM(t) > 0

If the Crude Oil Momentum crosses over the zero line from below, initiate a long position (buy) the dependent traded market Crude Oil (CL).

Sell: CL MOM(t-1) > 0 and CL MOM(t) < 0

If the Crude Oil Momentum crosses under the zero line from above, initiate a short position (sell short) the dependent traded market Crude Oil (CL).

5.2.11.5 Entry Rule Filters

Crude Oil intermarket correlations, volume confirmation and qualitative charting analysis were used to build trade entry rule filters to ensure that trades will only be entered into during those periods where Crude Oil price movement is supported by price trends in the independent intermarkets, high volume in the Crude Oil market and a supporting chart pattern or trendline breakout.

Inter-market Correlations:

Table 5-23: Inter-market Correlation Coefficients – Crude Oil (CL)

	CL	DX	AD	CD	RA	NOK	GI	XOI	US	TY	ED
CL	**1.00**										
DX	**-0.88**	1.00									
AD	**+0.90**	-0.94	1.00								
CD	**+0.94**	-0.93	+0.96*	1.00							
RA	**+0.23**	-0.66	+0.33	+0.46	1.00						
NOK	**+0.86**	-0.92	+0.84	+0.88	+0.42	1.00					
GI	**+0.99****	-0.89	+0.91	+0.95*	+0.48	+0.88	1.00				
XOI	**+0.92**	-0.84	+0.85	+0.89	+0.12	+0.84	+0.92	1.00			
US	**+0.81**	-0.76	+0.72	+0.78	-0.19	+0.44	+0.82	+0.67	1.00		
TY	**+0.74**	-0.70	+0.74	+0.70	-0.13	+0.39	+0.75	+0.55	+0.96*	1.00	
ED	**+0.55**	-0.50	+0.58	+0.51	+0.14	+0.52	+0.55	+0.35	+0.78	+0.89	1.00

Source: CSI Commodity Systems Inc.

As illustrated in Table 5-23, the intermarket correlations between Crude Oil (CL) and the US Dollar Index (DX), the Commodity Currencies (AD, CD, RA and NOK), Commodities (GI), the Amex Oil Stock Index (XOI), and US Treasury Bonds (US, TY and ED) were utilized to build trade entry rule filters whereby a Crude Oil (CL) long position was only initiated if it was supported by rising price momentum (MOM > 0) in the positively correlated independent intermarkets and falling price momentum (MOM < 0) in the negatively correlated independent intermarkets. Conversely, a Crude Oil (CL) short position was only initiated if it was supported by falling price momentum (MOM < 0) in the positively correlated independent intermarkets and rising price momentum (MOM > 0) in the negatively correlated independent intermarkets.

Volume:

A volume confirmation filter was utilized to ensure that Crude Oil long and short positions were only initiated when there was high volume in the Crude Oil market (CL Volume Oscillator > 0) which suggests that there is enough market support to continue driving the Crude Oil price in the direction of the momentum trend.

Qualitative Charting:

Each individual Crude Oil trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Therefore,

Only initiate a Crude Oil (CL) long position if:

The US Dollar Index (DX) MOM < 0

The Australian Dollar (AD) MOM > 0

The Canadian Dollar (CD) MOM > 0

The South African Rand (RA) MOM > 0

The Norwegian Krone (NOK) MOM > 0

The Commodity Index (GI) MOM > 0

The Amex Oil Stock Index (XOI) MOM > 0

The 30 year US Treasury Bond (US) MOM > 0

The 10 year US Treasury Note (TY) MOM > 0

The Eurodollar (ED) MOM > 0

The Crude Oil (CL) Volume Oscillator (Volume Osc) > 0 and

Finally, each individual long trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Only initiate a Crude Oil (CL) short position if:

The US Dollar Index (DX) MOM > 0

The Australian Dollar (AD) MOM < 0

The Canadian Dollar (CD) MOM < 0

The South African Rand (RA) MOM < 0

The Norwegian Krone (NOK) MOM < 0

The Commodity Index (GI) MOM < 0

The Amex Oil Stock Index (XOI) MOM < 0

The 30 year US Treasury Bond (US) MOM < 0

The 10 year US Treasury Note (TY) MOM < 0

The Eurodollar (ED) MOM < 0

The Crude Oil (CL) Volume Oscillator (Volume Osc) > 0 and

Finally, each individual short trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

5.2.11.6 Trade Exit Rules

The Crude Oil (CL) Momentum Indicator was used to signal trend reversals and the necessity to exit the trade position.

In a long Crude Oil (CL) position:

If the Crude Oil (CL) MOM crosses below the zero line, sell to close out the position.

In a short Crude Oil (CL) position:

If the Crude Oil (CL) MOM crosses above the zero line, buy to cover and close out the position.

5.2.11.7 Setting Up the Crude Oil Strategy TradeStation Workspace

Intra-day 240-minute data charts of Crude Oil (CL), Australian Dollar (AD), Canadian Dollar (CD), the South African Rand (RA), Norwegian Krone (NOK), the Commodity Index (GI), the Amex Oil Stock Index (XOI), the US Dollar Index (DX), the 30 year US Treasury Bond (US), the 10 year US Treasury Note (TY), and the Eurodollar (ED) for the period April 26, 2002 – Present were inserted into a TradeStation workspace.

A Crude Oil (CL) Volume Oscillator (Volume Osc) was applied in a sub-graph below the main chart, as illustrated by a snapshot of the TradeStation Workspace in Figure 5-9 below:

Figure 5-9: Crude Oil Strategy - TradeStation Workspace

Source: TradeStation, 2013

5.2.12 The 30 Year US Treasury Bond Trading Strategy

US Treasury Bond intermarket relationships identified by Ruggiero (1997) were utilized to develop an Intermarket Momentum trading strategy for the 30 Year US Treasury Bond (US).

5.2.12.1 The Trade Strategy Premise

The first intermarket relationship discussed by Ruggiero is that between Bonds and Stocks - there is generally a positive correlation between US Treasury Bonds and the S&P 500 resulting from the beneficial influence of a low interest rate environment on corporate profits and thus share prices. As Bond prices rise, Bond yields and interest rates fall, consequently corporate profits and share prices rise thus lifting stock markets (S&P 500) in conjunction with the rising Bond prices. As noted by Ruggiero, this positive linkage only decouples in periods of extreme market stress where there is a capital flight to the safety of US Treasury Bonds and the US Dollar. For example, as stock markets worldwide plummeted during the 2008 Financial Crisis, US Treasury Bonds and the US Dollar rallied.

Eurodollars, which represent dollar denominated deposits outside of the United States, are an accurate measure of short-term interest rates and positively correlated to Treasury Bonds. Falling Bond yields resulting from rising Bond prices will increase the demand for the yield generated by offshore Eurodollar deposits therefore one can expect 30 Year US Treasury Bonds (US) and 10 Year US Treasury Notes (TY) to be positively correlated to Eurodollars (ED).

As previously discussed, Treasury Bonds are positively correlated to Commodities (GI), Gold (GC), Crude Oil (CL) and foreign currencies, including the Japanese Yen (JY).

Ruggiero (1997: 17) further illustrates a positive correlation between Utilities and Treasury Bonds by charting the Philadelphia Utility Index (UTY) versus the 30 Year US Treasury Bond. The Utility sector is the most well-known of the defensive sectors that investors turn to during economic downturns: utility companies are basically legal monopolies that are regulated by the government which guarantees them specific rates regardless of the state of the economy. Utilization rates are also immune to economic downturns and these factors combined with the high dividend payout ratios of utilities ensure investors of an attractive fixed income from utility company investments even during recessionary periods. The Philadelphia Utility Index (UTY) therefore demonstrates the same characteristics as US Treasury Bonds - during economic downturns investors will flee to the safety of the UTY and Treasury Bonds.

Ruggiero (1997) also notes the inverse correlation between Copper and Lumber and Treasury Bonds. Copper and Lumber are materials used extensively in the home construction industry and are therefore accurate measures of economic activity since the housing sector is the most important barometer of the state of the economy. During economic upturns the demand for housing rises and this drives economic activity not only via the construction industry but also through ancillary demand for furniture, kitchen appliances, TV's etc. Consequently, a booming housing sector will raise Copper and Lumber prices and additionally stimulate the Federal Reserve to raise interest rates in an effort to cool down the economy and curb impending inflation. This action will reduce investor demand for the fixed coupon nature of

Treasury Bonds, resulting in falling Bond prices and the consequent negative correlation to Copper (HG) and Lumber (LB).

The afore-mentioned 30 Year US Treasury Bond (US) intermarket correlations were confirmed by the correlation lab software of CSI Commodity Systems Inc. as detailed below in Table 5-24:

Table 5-24: Correlation Coefficients - 30 Yr. US Treasury Bond Intermarket Relationships

NO. OF YEARS BACK	MARKET	MARKET	CORRELATION COEFFICIENT
30 Years	US	SP	+0.84
15 Years	US	TY	+0.96
20 Years	US	ED	+0.84
15 Years	US	GI	+0.82
15 Years	US	GC	+0.91
15 Years	US	CL	+0.81
35 Years	US	JY	+0.84
25 Years	US	UTY	+0.87
2 Years	US	HG	-0.15
20 Years	US	LB	-0.44

Source: CSI Commodity Systems Inc.

5.2.12.2 The Trade Data

The above identified inter-market relationships form the dependent traded market and independent intermarket data utilized in the development of an Intermarket Momentum trading strategy for the 30 Year US Treasury Bond (US) as detailed over-page in Table 5-25:

Table 5-25: Traded Market and Intermarket Data - 30 Year US Treasury Bond Strategy

DEPENDENT TRADED MARKET	TRADESTATION SYMBOL	INTRA-DAY HISTORICAL DATA
30 Yr. US Treasury Bond Custom Continuous Futures Contract	US	As of 10/25/2002
INDEPENDENT INTER-MARKET CURRENCIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
Japanese Yen Custom Continuous Contract	JY	As of 06/22/2001
INDEPENDENT INTER-MARKET COMMODITIES	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
S&P GSCI Commodity Index	GI	As of 08/16/2001
Copper Custom Continuous Contract	HG	As of 02/28/2002
Lumber Custom Continuous Contract	LB	As of 10/21/2008
Crude Oil Custom Continuous Contract	CL	As of 04/26/2002
Gold Custom Continuous Contract	GC	As of 10/22/2002
INDEPENDENT INTER-MARKET BONDS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
10 Yr. US Treasury Note Custom Continuous Futures Contract	TY	As of 09/30/2002
Eurodollar Custom Continuous Futures Contract	ED	As of 09/27/1994
INDEPENDENT INTER-MARKET STOCKS	**TRADESTATION SYMBOL**	**INTRA-DAY HISTORICAL DATA**
S&P 500 Custom Continuous Contract	SP	As of 03/08/2001
Philadelphia Utility Sector Index	UTY	As of 01/08/2001

Source: The Author, 2013

5.2.12.3 The Data Sample Period

Test set: Intra-day 240-minute data from October 25, 2002 – December 31, 2012

Live set: Intra-day 240-minute data from January 1, 2013 – present

5.2.12.4 The Trade Entry Rules

Breakout and price trend movements in the dependent traded market were identified by the standard Momentum (MOM) Indicator trading rule whereby a buy (sell) signal is triggered when the MOM crosses the zero line from below (above). Therefore, the following long and short MOM based trade entry rules were developed for the 30 year US Treasury Bond (US):

Buy: US MOM(t-1) < 0 and US MOM(t) > 0

If the 30 year US Treasury Bond Momentum crosses over the zero line from below, initiate a long position (buy) the dependent traded market 30 year US Treasury Bond (US).

Sell: US MOM(t-1) > 0 and US MOM(t) < 0

If the 30 year US Treasury Bond Momentum crosses under the zero line from above, initiate a short position (sell short) the dependent traded market 30 year US Treasury Bond (US).

5.2.12.5 Entry Rule Filters

30 year US Treasury Bond intermarket correlations, volume confirmation and qualitative charting analysis were used to build trade entry rule filters to ensure that trades will only be entered into during those periods where 30 year US Treasury Bond price movement is supported by price trends in the independent intermarkets, high volume in the 30 year US Treasury Bond market and a supporting chart pattern or trendline breakout.

Intermarket Correlations:

Table 5-26: Intermarket Correlation Coefficients – 30 year US Treasury Bond (US)

	US	JY	GI	HG	LB	CL	GC	TY	ED	SP	UTY
US	**1.00**										
JY	**+0.84**	1.00									
GI	**+0.82**	+0.68	1.00								
HG	**-0.15**	+0.69	+0.95*	1.00							
LB	**-0.44**	-0.10	-0.14	-0.08	1.00						
CL	**+0.81**	+0.68	+0.99**	+0.94	-0.14	1.00					
GC	**+0.91**	+0.76	+0.92	+0.89	-0.15	+0.91	1.00				
TY	**+0.96***	+0.70	+0.75	+0.64	-0.24	+0.74	+0.86	1.00			
ED	**+0.84**	+0.58	+0.55	+0.45	-0.17	+0.55	+0.71	+0.89	1.00		
SP	**+0.84**	+0.17	+0.34	+0.41	-0.12	+0.34	+0.16	+0.40	+0.19	1.00	
UTY	**+0.87**	+0.38	+0.82	+0.81	-0.07	+0.82	+0.71	+0.45	+0.20	+0.77	1.00

Source: CSI Commodity Systems Inc.

As illustrated above in Table 5-26, the intermarket correlations between the 30 year US Treasury Bond (US) and the Japanese Yen (JY), Commodities (GI), Copper (HG), Lumber (LB), Crude Oil (CL), Gold (GC), US Treasury Bonds (TY and ED), the S&P 500 Stock Index (SP), and the Philadelphia Utility Index (UTY) were

utilized to build trade entry rule filters whereby a 30 year US Treasury Bond (US) long position was only initiated if it was supported by rising price momentum (MOM > 0) in the positively correlated independent intermarkets and falling price momentum (MOM < 0) in the negatively correlated independent intermarkets. Conversely, a 30 year US Treasury Bond (US) short position was only initiated if it was supported by falling price momentum (MOM < 0) in the positively correlated independent intermarkets and rising price momentum (MOM > 0) in the negatively correlated independent intermarkets.

Volume:

A volume confirmation filter was utilized to ensure that 30 year US Treasury Bond long and short positions were only initiated when there was high volume in the 30 year US Treasury Bond market (US Volume Oscillator > 0) which suggests that there is enough market support to continue driving the 30 year US Treasury Bond price in the direction of the momentum trend.

Qualitative Charting:

Each individual 30 year US Treasury Bond trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Therefore,

Only initiate a 30 year US Treasury Bond (US) long position if:

The Japanese Yen (JY) MOM > 0

The Commodity Index (GI) MOM > 0

Copper (HG) MOM < 0

Lumber (LB) MOM < 0

Crude Oil (CL) MOM > 0

Gold (GC) MOM > 0

The 10 year US Treasury Note (TY) MOM > 0

The Eurodollar (ED) MOM > 0

The S&P 500 Stock Index (SP) MOM > 0

The Philadelphia Utility Index (UTY) MOM > 0

The 30 year US Treasury Bond (US) Volume Oscillator (Volume Osc) > 0 and

Finally, each individual long trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

Only initiate a 30 year US Treasury Bond (US) short position if:

The Japanese Yen (JY) MOM < 0

The Commodity Index (GI) MOM < 0

Copper (HG) MOM > 0

Lumber (LB) MOM > 0

Crude Oil (CL) MOM < 0

Gold (GC) MOM < 0

The 10 year US Treasury Note (TY) MOM < 0

The Eurodollar (ED) MOM < 0

The S&P 500 Stock Index (SP) MOM < 0

The Philadelphia Utility Index (UTY) MOM < 0

The 30 year US Treasury Bond (US) Volume Oscillator (Volume Osc) > 0 and

Finally, each individual short trade identified by the intermarket strategy was analyzed from a qualitative charting perspective in order to filter out those trades not supported by a chart pattern or a trendline breakout.

5.2.12.6 Trade Exit Rules

The 30 year US Treasury Bond (US) Momentum Indicator was used to signal trend reversals and the necessity to exit the trade position.

In a long 30 year US Treasury Bond (US) position:

If the 30 year US Treasury Bond (US) MOM crosses below the zero line, sell to close out the position.

In a short 30 year US Treasury Bond (US) position:

If the 30 year US Treasury Bond (US) MOM crosses above the zero line, buy to cover and close out the position.

5.2.12.7 Setting up the 30 year Treasury Bond Strategy TradeStation Workspace

Intra-day 240-minute data charts of the 30 year US Treasury Bond (US), the S&P 500 (SP), Copper (HG), Lumber (LB), the Philadelphia Utility Index (UTY), the 10 year US Treasury Note (TY), the Eurodollar (ED), Crude Oil (CL), the Japanese Yen (JY), the Commodity Index (GI), and Gold (GC) for the period October 25, 2002 – Present were inserted into a TradeStation workspace.

A 30 year US Treasury Bond (US) Volume Oscillator (Volume Osc) was applied in a sub-graph below the main chart, as illustrated by a snapshot of the TradeStation Workspace in Figure 5-10 below:

Figure 5-10: 30 Year US Treasury Bond Strategy - TradeStation Workspace

Source: TradeStation, 2013

5.3 Summary

TradeStation provides an extensive historical database of up to 60 years of clean and accurate daily, intraday and tick data for Indices, Stocks, Options, Futures and Forex.

The data was analyzed by utilizing Intermarket correlations, the Momentum trend Indicator, the Volume Oscillator Indicator and Qualitative Charting analysis to develop trade entry rules, trade entry filters, and trade exit rules for ten Intermarket Momentum strategies.

6 RESULTS

6.1 Trade List

Each long (short) trade entry exhibited a strong upward (downward) price trend in the form of rising (falling) channels of support and resistance lines. Therefore, on the basis of a qualitative charting perspective, no trades were filtered out thereby removing the potential of subjective bias influencing the trade results.

TradeStation's strategy performance reports listed the following trades generated by the portfolio of ten Intermarket Momentum trading strategies as enumerated below in Tables 6-1 through 6-6.

The details of each individual trade are tabulated, including the date and price of the trade entry and exit, the strategy generating the trade, the nature of the trade (long or short position), the number of Futures contracts, the gross profit, the broker commission and slippage incurred, the net profit after accounting for broker commission and slippage, and finally the cumulative portfolio capital balance.

Table 6-1: Trade List for the Year 2008

TRADE ENTRY	STRATEGY	TRADE	PRICE	CONTRACTS	TRADE EXIT	TRADE	PRICE	PROFIT / (LOSS)	COMMISSION	SLIPPAGE	NET PROFIT	CUM. PF CAPITAL
												$1,000,000.00
29-Feb-08	S.A. Rand	Buy	$1.0641	5	29-Feb-08	Sell	$1.0444	49,375.00	16.00	100.00	49,491.00	$950,509.00
28-Feb-08	Commodity Index	Buy	$904.20	20	5-Mar-08	Sell	$896.90	36,500.00	54.00	100.00	36,654.00	$913,855.00
13-Mar-08	S.A. Rand	Buy	$1.0346	5	13-Mar-08	Sell	$1.0411	16,250.00	16.00	100.00	16,134.00	$929,989.00
13-Mar-08	Crude Oil	Buy	$108.57	15	17-Mar-08	Sell	$106.22	35,250.00	43.50	100.00	35,393.50	$894,595.50
14-Mar-08	S.A. Rand	Buy	$1.0354	5	17-Mar-08	Sell	$0.9911	110,625.00	16.00	100.00	110,741.00	$783,854.50
28-Feb-08	Canadian Dollar	Buy	$0.9976	75	19-Mar-08	Sell	$0.9873	77,250.00	240.00	100.00	77,590.00	$706,264.50
22-Apr-08	Canadian Dollar	Buy	$0.9744	75	23-Apr-08	Sell	$0.9626	88,500.00	240.00	100.00	88,840.00	$617,424.50
22-Apr-08	Crude Oil	Buy	$115.15	15	24-Apr-08	Sell	$114.10	15,750.00	43.50	100.00	15,893.50	$601,531.00
13-Mar-08	Norwegian Krone	Buy	$0.1791	130	25-Apr-08	Sell	$0.1784	18,980.00	416.00	100.00	19,496.00	$582,035.00
21-Apr-08	S.A. Rand	Buy	$1.0634	5	7-May-08	Sell	$1.1011	94,375.00	16.00	100.00	94,259.00	$676,294.00
26-Jun-08	Commodity Index	Buy	$1,099.00	20	7-Jul-08	Sell	$1,102.60	18,000.00	54.00	100.00	17,846.00	$694,140.00
27-Jun-08	Crude Oil	Buy	$146.50	15	8-Jul-08	Sell	$146.14	5,400.00	43.50	100.00	5,543.50	$688,596.50
29-Feb-08	Australian Dollar	Buy	$0.8164	50	5-Aug-08	Sell	$0.8085	39,500.00	160.00	100.00	39,760.00	$648,836.50
1-Jul-08	Canadian Dollar	Buy	$0.9647	75	7-Aug-08	Sell	$0.9404	182,250.00	240.00	100.00	182,590.00	$466,246.50
8-Sep-08	S.A. Rand	Sell Short	$1.0809	5	18-Sep-08	Buy to Cover	$1.0511	74,375.00	16.00	100.00	74,259.00	$540,505.50
7-Sep-08	Crude Oil	Sell Short	$117.94	15	18-Sep-08	Buy to Cover	$108.86	136,200.00	43.50	100.00	136,056.50	$676,562.00
8-Sep-08	Commodity Index	Sell Short	$891.10	20	19-Sep-08	Buy to Cover	$866.05	125,250.00	54.00	100.00	125,096.00	$801,658.00

Trade List for the Year 2008 (continued)

TRADE ENTRY	STRATEGY	TRADE	PRICE	CONTRACTS	TRADE EXIT	TRADE	PRICE	PROFIT / (LOSS)	COMMISSION	SLIPPAGE	NET PROFIT	CUM. PF CAPITAL
												$801,658.00
1-Oct-08	Crude Oil	Sell Short	$110.46	15	1-Oct-08	Buy to Cover	$110.67	3,150.00	43.50	100.00	3,293.50	$798,364.50
2-Oct-08	Crude Oil	Sell Short	$109.10	15	8-Oct-08	Buy to Cover	$101.96	107,100.00	43.50	100.00	106,956.50	$905,321.00
9-Oct-08	Crude Oil	Sell Short	$100.74	15	9-Oct-08	Buy to Cover	$100.87	1,950.00	43.50	100.00	2,093.50	$903,227.50
9-Oct-08	Crude Oil	Sell Short	$99.35	15	13-Oct-08	Buy to Cover	$98.65	10,500.00	43.50	100.00	10,356.50	$913,584.00
10-Oct-08	Norwegian Krone	Sell Short	$0.1485	130	14-Oct-08	Buy to Cover	$0.1498	34,060.00	416.00	100.00	34,576.00	$879,008.00
9-Oct-08	S.A. Rand	Sell Short	$0.9376	5	21-Oct-08	Buy to Cover	$0.8171	301,250.00	16.00	100.00	301,134.00	$1,180,142.00
9-Oct-08	Commodity Index	Sell Short	$766.35	20	29-Oct-08	Buy to Cover	$669.80	482,750.00	54.00	100.00	482,596.00	$1,662,738.00
15-Oct-08	Norwegian Krone	Sell Short	$0.1450	130	4-Nov-08	Buy to Cover	$0.1382	177,320.00	416.00	100.00	176,804.00	$1,839,542.00

Source: TradeStation, 2013

Table 6-2: Trade List for the Year 2009

TRADE ENTRY	STRATEGY	TRADE	PRICE	CONTRACTS	TRADE EXIT	TRADE	PRICE	PROFIT / (LOSS)	COMMISSION	SLIPPAGE	NET PROFIT	CUM. PF CAPITAL
												$1,839,542.00
20-Jan-09	Crude Oil	Sell Short	$70.32	25	26-Jan-09	Buy to Cover	$69.86	$11,500.00	$72.50	$100.00	$11,327.50	$1,850,869.50

Source: TradeStation, 2013

Table 6-3: Trade List for the Year 2010

TRADE ENTRY	STRATEGY	TRADE	PRICE	CONTRACTS	TRADE EXIT	TRADE	PRICE	PROFIT / (LOSS)	COMMISSION	SLIPPAGE	NET PROFIT	CUM. PF CAPITAL
												$1,850,869.50
4-Oct-10	Crude Oil	Buy	$90.43	25	7-Oct-10	Sell	$90.43	$0.00	$72.50	$100.00	$172.50	$1,850,697.00
4-Oct-10	Commodity Index	Buy	$585.10	35	15-Oct-10	Sell	$599.80	$128,625.00	$94.50	$100.00	$128,430.50	$1,979,127.50
4-Nov-10	Crude Oil	Buy	$94.53	25	8-Nov-10	Sell	$94.27	$6,500.00	$72.50	$100.00	$6,672.50	$1,972,455.00
4-Nov-10	Norwegian Krone	Buy	$0.1677	240	10-Nov-10	Sell	$0.1643	$162,240.00	$768.00	$100.00	$163,108.00	$1,809,347.00
4-Nov-10	Commodity Index	Buy	$622.35	35	12-Nov-10	Sell	$614.40	$69,562.50	$94.50	$100.00	$69,757.00	$1,739,590.00

Source: TradeStation, 2013

Table 6-4: Trade List for the Year 2011

TRADE ENTRY	STRATEGY	TRADE	PRICE	CONTRACTS	TRADE EXIT	TRADE	PRICE	PROFIT / (LOSS)	COMMISSION	SLIPPAGE	NET PROFIT	CUM. PF CAPITAL
												$1,739,590.00
3-Jan-11	Commodity Index	Buy	$657.80	35	4-Jan-11	Sell	$647.05	$94,062.50	$94.50	$100.00	$94,257.00	$1,645,333.00
3-Jan-11	Crude Oil	Buy	$99.04	25	4-Jan-11	Sell	$96.28	$69,000.00	$72.50	$100.00	$69,172.50	$1,576,160.50
3-Jan-11	Norwegian Krone	Buy	$0.1649	240	6-Jan-11	Sell	$0.1613	$168,480.00	$768.00	$100.00	$169,348.00	$1,406,812.50
17-Feb-11	Platinum	Buy	$1,891.30	55	22-Feb-11	Sell	$1,883.10	$22,550.00	$159.50	$100.00	$22,809.50	$1,384,003.00
18-Feb-11	US Treasury Bond	Buy	$108.5625	80	1-Mar-11	Sell	$110.6563	$167,500.00	$256.00	$100.00	$167,144.00	$1,551,147.00
7-Mar-11	Canadian Dollar	Buy	$1.0067	135	7-Mar-11	Sell	$1.0028	$52,650.00	$432.00	$100.00	$53,182.00	$1,497,965.00
7-Mar-11	Crude Oil	Buy	$107.76	25	8-Mar-11	Sell	$107.15	$15,250.00	$72.50	$100.00	$15,422.50	$1,482,542.50
28-Feb-11	Commodity Index	Buy	$700.65	35	10-Mar-11	Sell	$714.95	$125,125.00	$94.50	$100.00	$124,930.50	$1,607,473.00
31-Mar-11	Platinum	Buy	$1,812.40	55	1-Apr-11	Sell	$1,814.40	$5,500.00	$159.50	$100.00	$5,240.50	$1,612,713.50
31-Mar-11	US Treasury Bond	Buy	$111.0625	80	3-Apr-11	Sell	$111.3125	$20,000.00	$256.00	$100.00	$19,644.00	$1,632,357.50
31-Mar-11	Crude Oil	Buy	$107.76	25	5-Apr-11	Sell	$109.22	$36,500.00	$72.50	$100.00	$36,327.50	$1,668,685.00
4-Apr-11	US Treasury Bond	Buy	$111.6250	80	5-Apr-11	Sell	$111.1563	$37,500.00	$256.00	$100.00	$37,856.00	$1,630,829.00
31-Mar-11	Commodity Index	Buy	$729.95	35	12-Apr-11	Sell	$730.95	$8,750.00	$94.50	$100.00	$8,555.50	$1,639,384.50
4-Apr-11	Canadian Dollar	Buy	$1.0094	135	12-Apr-11	Sell	$1.0140	$62,100.00	$432.00	$100.00	$61,568.00	$1,700,952.50
25-Apr-11	Crude Oil	Buy	$111.99	25	25-Apr-11	Sell	$112.35	$9,000.00	$72.50	$100.00	$8,827.50	$1,709,780.00
25-Apr-11	Canadian Dollar	Buy	$1.0239	135	25-Apr-11	Sell	$1.0242	$4,050.00	$432.00	$100.00	$3,518.00	$1,713,298.00
26-Apr-11	Canadian Dollar	Buy	$1.0285	135	27-Apr-11	Sell	$1.0240	$60,750.00	$432.00	$100.00	$61,282.00	$1,652,016.00
28-Apr-11	US Treasury Bond	Buy	$113.1250	80	28-Apr-11	Sell	$113.0000	$10,000.00	$256.00	$100.00	$10,356.00	$1,641,660.00
27-Apr-11	Crude Oil	Buy	$112.10	25	1-May-11	Sell	$113.70	$40,000.00	$72.50	$100.00	$39,827.50	$1,681,487.50
29-Apr-11	Canadian Dollar	Buy	$1.0350	135	2-May-11	Sell	$1.0308	$56,700.00	$432.00	$100.00	$57,232.00	$1,624,255.50
25-Apr-11	Commodity Index	Buy	$747.10	35	3-May-11	Sell	$748.20	$9,625.00	$94.50	$100.00	$9,430.50	$1,633,686.00
29-Apr-11	Platinum	Buy	$1,922.10	55	3-May-11	Sell	$1,903.60	$50,875.00	$159.50	$100.00	$51,134.50	$1,582,551.50
17-Feb-11	Silver	Buy	$31.500	10	3-May-11	Sell	$40.250	$437,500.00	$29.00	$100.00	$437,371.00	$2,019,922.50
3-May-11	Canadian Dollar	Buy	$1.0335	135	3-May-11	Sell	$1.0280	$74,250.00	$432.00	$100.00	$74,782.00	$1,945,140.50
28-Feb-11	S.A. Rand	Buy	$0.1258	70	13-May-11	Sell	$0.1287	$103,250.00	$224.00	$100.00	$102,926.00	$2,048,066.50
7-Oct-10	Australian Dollar	Buy	$0.8699	80	2-Jun-11	Sell	$0.9763	$851,200.00	$256.00	$100.00	$850,844.00	$2,898,910.50
2-Jun-11	Canadian Dollar	Buy	$1.0041	135	2-Jun-11	Sell	$1.0045	$5,400.00	$432.00	$100.00	$4,868.00	$2,903,778.50
2-Jun-11	Norwegian Krone	Buy	$0.1804	240	9-Jun-11	Sell	$0.1786	$86,400.00	$768.00	$100.00	$87,268.00	$2,816,510.50
8-Jun-11	Commodity Index	Buy	$705.35	35	13-Jun-11	Sell	$701.00	$38,062.50	$94.50	$100.00	$38,257.00	$2,778,253.50
13-Jul-11	Platinum	Buy	$1,800.00	55	15-Jul-11	Sell	$1,799.60	$1,100.00	$159.50	$100.00	$1,359.50	$2,776,894.00
25-Jul-11	Platinum	Buy	$1,833.10	55	25-Jul-11	Sell	$1,819.10	$38,500.00	$159.50	$100.00	$38,759.50	$2,738,134.50
26-Jul-11	Canadian Dollar	Buy	$1.0400	135	27-Jul-11	Sell	$1.0327	$98,550.00	$432.00	$100.00	$99,082.00	$2,639,052.50
27-Jul-11	Crude Oil	Buy	$98.23	25	27-Jul-11	Sell	$97.76	$11,750.00	$72.50	$100.00	$11,922.50	$2,627,130.00
26-Jul-11	Australian Dollar	Buy	$1.0127	80	29-Jul-11	Sell	$1.0124	$2,400.00	$256.00	$100.00	$2,756.00	$2,624,374.00
12-Dec-11	Platinum	Sell Short	$1,521.70	55	16-Dec-11	Buy to Cover	$1,457.20	$177,375.00	$159.50	$100.00	$177,115.50	$2,801,489.50

Source: TradeStation, 2013

Table 6-5: Trade List for the Year 2012

TRADE ENTRY	STRATEGY	TRADE	PRICE	CONTRACTS	TRADE EXIT	TRADE	PRICE	PROFIT / (LOSS)	COMMISSION	SLIPPAGE	NET PROFIT	CUM. PF CAPITAL
												$2,801,489.50
26-Jan-12	Crude Oil	Buy	$98.45	35	27-Jan-12	Sell	$97.56	$31,150.00	$101.50	$100.00	$31,351.50	$2,770,138.00
23-Feb-12	Platinum	Buy	$1,757.20	80	24-Feb-12	Sell	$1,742.00	$60,800.00	$232.00	$100.00	$61,132.00	$2,709,006.00
28-Feb-12	Commodity Index	Buy	$700.10	50	29-Feb-12	Sell	$697.05	$38,125.00	$135.00	$100.00	$38,360.00	$2,670,646.00
29-Feb-12	Australian Dollar	Buy	$1.0255	120	29-Feb-12	Sell	$1.0188	$80,400.00	$384.00	$100.00	$80,884.00	$2,589,762.00
28-Feb-12	Canadian Dollar	Buy	$0.9918	200	2-Mar-12	Sell	$0.9978	$120,000.00	$640.00	$100.00	$119,260.00	$2,709,022.00
28-Feb-12	Norwegian Krone	Buy	$0.1755	360	2-Mar-12	Sell	$0.1740	$109,440.00	$1,152.00	$100.00	$110,692.00	$2,598,330.00
23-Feb-12	Silver	Buy	$35.095	15	6-Mar-12	Sell	$32.940	$161,625.00	$43.50	$100.00	$161,768.50	$2,436,561.50
27-Mar-12	Canadian Dollar	Buy	$0.9935	200	28-Mar-12	Sell	$0.9894	$82,000.00	$640.00	$100.00	$82,740.00	$2,353,821.50
4-Apr-12	Crude Oil	Sell Short	$98.70	35	9-Apr-12	Buy to Cover	$98.73	$1,050.00	$101.50	$100.00	$1,251.50	$2,352,570.00
26-Apr-12	Crude Oil	Buy	$100.50	35	30-Apr-12	Sell	$99.80	$24,500.00	$101.50	$100.00	$24,701.50	$2,327,868.50
16-May-12	Crude Oil	Sell Short	$89.81	35	21-May-12	Buy to Cover	$88.77	$36,400.00	$101.50	$100.00	$36,198.50	$2,364,067.00
22-Jun-12	Platinum	Sell Short	$1,457.30	80	25-Jun-12	Buy to Cover	$1,463.60	$25,200.00	$232.00	$100.00	$25,532.00	$2,338,535.00
2-Aug-12	Platinum	Sell Short	$1,408.10	80	3-Aug-12	Buy to Cover	$1,418.00	$39,600.00	$232.00	$100.00	$39,932.00	$2,298,603.00
19-Aug-12	Platinum	Buy	$1,493.60	80	26-Aug-12	Sell	$1,572.40	$315,200.00	$232.00	$100.00	$314,868.00	$2,613,471.00
10-Sep-12	Commodity Index	Buy	$677.90	50	17-Sep-12	Sell	$673.70	$52,500.00	$135.00	$100.00	$52,735.00	$2,560,736.00

Source: TradeStation, 2013

Table 6-6: Trade List for the Year 2013

TRADE ENTRY	STRATEGY	TRADE	PRICE	CONTRACTS	TRADE EXIT	TRADE	PRICE	PROFIT / (LOSS)	COMMISSION	SLIPPAGE	NET PROFIT	CUM. PF CAPITAL
												$2,560,736.00
4-Jan-13	Platinum	Sell Short	$1,560.70	80	6-Jan-13	Buy to Cover	$1,580.50	$79,200.00	$232.00	$100.00	$79,532.00	$2,481,204.00
4-Jan-13	Silver	Sell Short	$29.845	15	7-Jan-13	Buy to Cover	$30.325	$36,000.00	$43.50	$100.00	$36,143.50	$2,445,060.50
24-Jan-13	Platinum	Sell Short	$1,695.20	80	25-Jan-13	Buy to Cover	$1,705.90	$42,800.00	$232.00	$100.00	$43,132.00	$2,401,928.50
24-Jan-13	Silver	Sell Short	$31.845	15	30-Jan-13	Buy to Cover	$31.650	$14,625.00	$43.50	$100.00	$14,481.50	$2,416,410.00
18-Feb-13	Platinum	Sell Short	$1,704.70	80	18-Feb-13	Buy to Cover	$1,709.90	$20,800.00	$232.00	$100.00	$21,132.00	$2,395,278.00
11-Feb-13	Silver	Sell Short	$31.240	15	22-Feb-13	Buy to Cover	$28.835	$180,375.00	$43.50	$100.00	$180,231.50	$2,575,509.50
4-Jan-13	Gold	Sell Short	$1,679.00	25	18-Mar-13	Buy to Cover	$1,626.90	$130,250.00	$72.50	$100.00	$130,077.50	$2,705,587.00
17-Apr-13	Australian Dollar	Sell Short	$1.0140	120	19-Apr-13	Buy to Cover	$1.0141	$1,200.00	$384.00	$100.00	$1,684.00	$2,703,903.00
17-Apr-13	Canadian Dollar	Sell Short	$0.9684	200	19-Apr-13	Buy to Cover	$0.9704	$40,000.00	$640.00	$100.00	$40,740.00	$2,663,163.00
17-Apr-13	Crude Oil	Sell Short	$78.03	35	19-Apr-13	Buy to Cover	$80.66	$92,050.00	$101.50	$100.00	$92,251.50	$2,570,911.50
29-Apr-13	Crude Oil	Buy	$85.85	35	1-May-13	Sell	$83.82	$71,050.00	$101.50	$100.00	$71,251.50	$2,499,660.00
10-May-13	Norwegian Krone	Sell Short	$0.1702	360	13-May-13	Buy to Cover	$0.1706	$26,640.00	$1,152.00	$100.00	$27,892.00	$2,471,768.00
10-May-13	Silver	Sell Short	$23.420	15	14-May-13	Buy to Cover	$23.480	$4,500.00	$43.50	$100.00	$4,643.50	$2,467,124.50
10-May-13	Platinum	Sell Short	$1,487.70	80	14-May-13	Buy to Cover	$1,501.80	$56,400.00	$232.00	$100.00	$56,732.00	$2,410,392.50
10-May-13	Crude Oil	Sell Short	$87.47	35	14-May-13	Buy to Cover	$86.36	$38,850.00	$101.50	$100.00	$38,648.50	$2,449,041.00
10-May-13	Canadian Dollar	Sell Short	$0.9831	200	16-May-13	Buy to Cover	$0.9793	$76,000.00	$640.00	$100.00	$75,260.00	$2,524,301.00
13-May-13	US Treasury Bond	Sell Short	$142.4063	65	16-May-13	Buy to Cover	$142.8750	$30,468.75	$208.00	$100.00	$30,776.75	$2,493,524.25
16-May-13	Gold	Sell Short	$1,392.80	25	17-May-13	Buy to Cover	$1,401.40	$21,500.00	$72.50	$100.00	$21,672.50	$2,471,851.75
16-May-13	Silver	Sell Short	$22.335	15	20-May-13	Buy to Cover	$22.805	$35,250.00	$43.50	$100.00	$35,393.50	$2,436,458.25
16-May-13	Platinum	Sell Short	$1,477.20	80	20-May-13	Buy to Cover	$1,494.30	$68,400.00	$232.00	$100.00	$68,732.00	$2,367,726.25
10-May-13	Australian Dollar	Sell Short	$0.9856	120	20-May-13	Buy to Cover	$0.9680	$211,200.00	$384.00	$100.00	$210,716.00	$2,578,442.25
15-May-13	Norwegian Krone	Sell Short	$0.1693	360	21-May-13	Buy to Cover	$0.1709	$121,680.00	$1,152.00	$100.00	$122,932.00	$2,455,510.25
22-May-13	Norwegian Krone	Sell Short	$0.1704	360	23-May-13	Buy to Cover	$0.1695	$61,920.00	$1,152.00	$100.00	$60,668.00	$2,516,178.25
22-May-13	Silver	Sell Short	$22.460	15	23-May-13	Buy to Cover	$22.460	$0.00	$43.50	$100.00	$143.50	$2,516,034.75
22-May-13	Platinum	Sell Short	$1,470.10	80	23-May-13	Buy to Cover	$1,461.30	$35,200.00	$232.00	$100.00	$34,868.00	$2,550,902.75
10-May-13	S.A. Rand	Sell Short	$0.1066	100	24-May-13	Buy to Cover	$0.1019	$232,500.00	$320.00	$100.00	$232,080.00	$2,782,982.75
22-May-13	Australian Dollar	Sell Short	$0.9552	120	24-May-13	Buy to Cover	$0.9544	$9,600.00	$384.00	$100.00	$9,116.00	$2,792,098.75
22-May-13	Canadian Dollar	Sell Short	$0.9584	200	24-May-13	Buy to Cover	$0.9639	$110,000.00	$640.00	$100.00	$110,740.00	$2,681,358.75
22-May-13	Commodity Index	Sell Short	$612.70	50	30-May-13	Buy to Cover	$610.85	$23,125.00	$135.00	$100.00	$22,890.00	$2,704,248.75

Trade List for the Year 2013 (continued)

TRADE ENTRY	STRATEGY	TRADE	PRICE	CONTRACTS	TRADE EXIT	TRADE	PRICE	PROFIT / (LOSS)	COMMISSION	SLIPPAGE	NET PROFIT	CUM. PF CAPITAL
												$2,704,248.75
30-May-13	Silver	Buy	$22.810	15	31-May-13	Sell	$22.300	$38,250.00	$43.50	$100.00	$38,393.50	$2,665,855.25
30-May-13	Platinum	Buy	$1,490.80	80	3-Jun-13	Sell	$1,471.90	$75,600.00	$232.00	$100.00	$75,932.00	$2,589,923.25
6-Jun-13	Silver	Buy	$22.670	15	7-Jun-13	Sell	$22.060	$45,750.00	$43.50	$100.00	$45,893.50	$2,544,029.75
6-Jun-13	Platinum	Buy	$1,534.70	80	7-Jun-13	Sell	$1,511.00	$94,800.00	$232.00	$100.00	$95,132.00	$2,448,897.75
20-Jun-13	Australian Dollar	Sell Short	$0.9094	120	24-Jun-13	Buy to Cover	$0.9078	$19,200.00	$384.00	$100.00	$18,716.00	$2,467,613.75
20-Jun-13	Silver	Sell Short	$20.110	15	24-Jun-13	Buy to Cover	$19.860	$18,750.00	$43.50	$100.00	$18,606.50	$2,486,220.25
20-Jun-13	Crude Oil	Sell Short	$86.13	35	25-Jun-13	Buy to Cover	$86.15	$700.00	$101.50	$100.00	$901.50	$2,485,318.75
21-Jun-13	S.A. Rand	Sell Short	$0.0956	100	25-Jun-13	Buy to Cover	$0.0983	$132,500.00	$320.00	$100.00	$132,920.00	$2,352,398.75
20-Jun-13	Canadian Dollar	Sell Short	$0.9625	200	26-Jun-13	Buy to Cover	$0.9489	$272,000.00	$640.00	$100.00	$271,260.00	$2,623,658.75
24-Jun-13	US Treasury Bond	Sell Short	$133.4063	65	26-Jun-13	Buy to Cover	$132.8438	$36,562.50	$208.00	$100.00	$36,254.50	$2,659,913.25
20-Jun-13	Norwegian Krone	Sell Short	$0.1674	360	27-Jun-13	Buy to Cover	$0.1642	$226,800.00	$1,152.00	$100.00	$225,548.00	$2,885,461.25
21-Jun-13	Commodity Index	Sell Short	$605.25	50	27-Jun-13	Buy to Cover	$609.35	$51,250.00	$135.00	$100.00	$51,485.00	$2,833,976.25
20-Jun-13	Platinum	Sell Short	$1,406.00	80	28-Jun-13	Buy to Cover	$1,335.30	$282,800.00	$232.00	$100.00	$282,468.00	$3,116,444.25
21-Jun-13	Gold	Sell Short	$1,316.10	25	1-Jul-13	Buy to Cover	$1,274.00	$105,250.00	$72.50	$100.00	$105,077.50	$3,221,521.75
11-Jul-13	Silver	Buy	$19.985	15	12-Jul-13	Sell	$19.935	$3,750.00	$43.50	$100.00	$3,893.50	$3,217,628.25
11-Jul-13	Australian Dollar	Buy	$0.9074	120	12-Jul-13	Sell	$0.9068	$7,200.00	$384.00	$100.00	$7,684.00	$3,209,944.25
11-Jul-13	Canadian Dollar	Buy	$0.9601	200	12-Jul-13	Sell	$0.9580	$42,000.00	$640.00	$100.00	$42,740.00	$3,167,204.25
11-Jul-13	Crude Oil	Buy	$91.71	35	16-Jul-13	Sell	$92.00	$10,150.00	$101.50	$100.00	$9,948.50	$3,177,152.75
11-Jul-13	Platinum	Buy	$1,408.20	80	17-Jul-13	Sell	$1,421.70	$54,000.00	$232.00	$100.00	$53,668.00	$3,230,820.75
17-Jul-13	Australian Dollar	Buy	$0.9130	120	18-Jul-13	Sell	$0.9064	$79,200.00	$384.00	$100.00	$79,684.00	$3,151,136.75
17-Jul-13	Canadian Dollar	Buy	$0.9562	200	18-Jul-13	Sell	$0.9594	$64,000.00	$640.00	$100.00	$63,260.00	$3,214,396.75
23-Jul-13	Platinum	Buy	$1,441.80	80	23-Jul-13	Sell	$1,432.90	$35,600.00	$232.00	$100.00	$35,932.00	$3,178,464.75
16-Jul-13	Commodity Index	Buy	$643.30	50	24-Jul-13	Sell	$646.10	$35,000.00	$135.00	$100.00	$34,765.00	$3,213,229.75
19-Jul-13	Silver	Buy	$19.520	15	24-Jul-13	Sell	$20.280	$57,000.00	$43.50	$100.00	$56,856.50	$3,270,086.25
22-Aug-13	Crude Oil	Sell Short	$93.13	35	22-Aug-13	Buy to Cover	$93.29	$5,600.00	$101.50	$100.00	$5,801.50	$3,264,284.75
9-Sep-13	Crude Oil	Buy	$93.76	35	9-Sep-13	Sell	$93.53	$8,050.00	$101.50	$100.00	$8,251.50	$3,256,033.25
18-Sep-13	Platinum	Sell Short	$1,423.30	80	18-Sep-13	Buy to Cover	$1,457.10	$135,200.00	$232.00	$100.00	$135,532.00	$3,120,501.25
18-Sep-13	Crude Oil	Buy	$94.19	35	20-Sep-13	Sell	$93.38	$28,350.00	$101.50	$100.00	$28,551.50	$3,091,949.75
11-Oct-13	Crude Oil	Buy	$93.74	35	14-Oct-13	Sell	$94.08	$11,900.00	$101.50	$100.00	$11,698.50	$3,103,648.25
9-Oct-13	Silver	Sell Short	$21.870	15	15-Oct-13	Buy to Cover	$21.385	$36,375.00	$43.50	$100.00	$36,231.50	$3,139,879.75

Trade List for the Year 2013 (continued)

16-Oct-13	Platinum	Sell Short	$1,386.50	80	16-Oct-13	Buy to Cover	$1,399.70	$52,800.00	$232.00	$100.00	$53,132.00	$3,086,747.75
16-Oct-13	Silver	Sell Short	$21.165	15	16-Oct-13	Buy to Cover	$21.350	$13,875.00	$43.50	$100.00	$14,018.50	$3,072,729.25
17-Oct-13	Crude Oil	Buy	$94.67	35	17-Oct-13	Sell	$93.90	$26,950.00	$101.50	$100.00	$27,151.50	$3,045,577.75
17-Oct-13	Gold	Buy	$1,334.90	25	18-Oct-13	Sell	$1,331.40	$8,750.00	$72.50	$100.00	$8,922.50	$3,036,655.25
17-Oct-13	Platinum	Buy	$1,437.50	80	21-Oct-13	Sell	$1,435.90	$6,400.00	$232.00	$100.00	$6,732.00	$3,029,923.25
17-Oct-13	Canadian Dollar	Buy	$0.9706	200	21-Oct-13	Sell	$0.9703	$6,000.00	$640.00	$100.00	$6,740.00	$3,023,183.25
17-Oct-13	Australian Dollar	Buy	$0.9600	120	22-Oct-13	Sell	$0.9627	$32,400.00	$384.00	$100.00	$31,916.00	$3,055,099.25
17-Oct-13	Silver	Buy	$21.925	15	24-Oct-13	Sell	$22.730	$60,375.00	$43.50	$100.00	$60,231.50	$3,115,330.75
17-Oct-13	S.A. Rand	Buy	$0.1011	100	28-Oct-13	Sell	$0.1009	$10,000.00	$320.00	$100.00	$10,420.00	$3,104,910.75
17-Oct-13	Norwegian Krone	Buy	$0.1683	360	31-Oct-13	Sell	$0.1680	$18,720.00	$1,152.00	$100.00	$19,972.00	$3,084,938.75
8-Nov-13	Commodity Index	Sell Short	$607.65	50	11-Nov-13	Buy to Cover	$615.05	$92,500.00	$135.00	$100.00	$92,735.00	$2,992,203.75
8-Nov-13	Crude Oil	Sell Short	$90.60	35	11-Nov-13	Buy to Cover	$91.18	$20,300.00	$101.50	$100.00	$20,501.50	$2,971,702.25
11-Nov-13	Crude Oil	Sell Short	$90.71	35	11-Nov-13	Buy to Cover	$91.13	$14,700.00	$101.50	$100.00	$14,901.50	$2,956,800.75
8-Nov-13	US Treasury Bond	Sell Short	$131.7500	65	12-Nov-13	Buy to Cover	$131.7813	$2,031.25	$208.00	$100.00	$2,339.25	$2,954,461.50
8-Nov-13	Canadian Dollar	Sell Short	$0.9524	200	13-Nov-13	Buy to Cover	$0.9546	$44,000.00	$640.00	$100.00	$44,740.00	$2,909,721.50
8-Nov-13	S.A. Rand	Sell Short	$0.0962	100	13-Nov-13	Buy to Cover	$0.0969	$33,750.00	$320.00	$100.00	$34,170.00	$2,875,551.50
8-Nov-13	Platinum	Sell Short	$1,442.00	80	13-Nov-13	Buy to Cover	$1,436.70	$21,200.00	$232.00	$100.00	$20,868.00	$2,896,419.50
8-Nov-13	Australian Dollar	Sell Short	$0.9351	120	13-Nov-13	Buy to Cover	$0.9345	$7,200.00	$384.00	$100.00	$6,716.00	$2,903,135.50
8-Nov-13	Silver	Sell Short	$21.345	15	14-Nov-13	Buy to Cover	$20.740	$45,375.00	$43.50	$100.00	$45,231.50	$2,948,367.00
8-Nov-13	Norwegian Krone	Sell Short	$0.1621	360	15-Nov-13	Buy to Cover	$0.1631	$75,600.00	$1,152.00	$100.00	$76,852.00	$2,871,515.00
15-Nov-13	Crude Oil	Buy	$91.81	35	17-Nov-13	Sell	$91.59	$7,700.00	$101.50	$100.00	$7,901.50	$2,863,613.50
18-Nov-13	Crude Oil	Buy	$91.51	35	18-Nov-13	Sell	$91.74	$8,050.00	$101.50	$100.00	$7,848.50	$2,871,462.00
2-Dec-13	Silver	Sell Short	$19.50	15	4-Dec-13	Buy to Cover	$19.82	$23,625.00	$43.50	$100.00	$23,768.50	$2,847,693.50
8-Nov-13	Gold	Sell Short	$1,299.50	25	5-Dec-13	Buy to Cover	$1,251.10	$121,000.00	$72.50	$100.00	$120,827.50	$2,968,521.00
10-Dec-13	Gold	Buy	$1,257.00	25	12-Dec-13	Sell	$1,236.50	$51,250.00	$72.50	$100.00	$51,422.50	$2,917,098.50
12-Dec-13	US Treasury Bond	Sell Short	$129.31	65	13-Dec-13	Buy to Cover	$129.63	$20,312.50	$208.00	$100.00	$20,620.50	$2,896,478.00
13-Dec-13	Canadian Dollar	Sell Short	$0.9361	200	13-Dec-13	Buy to Cover	$0.9402	$82,000.00	$640.00	$100.00	$82,740.00	$2,813,738.00
13-Dec-13	Australian Dollar	Sell Short	$0.8859	120	16-Dec-13	Buy to Cover	$0.8879	$24,000.00	$384.00	$100.00	$24,484.00	$2,789,254.00
19-Dec-13	Silver	Sell Short	$19.360	15	23-Dec-13	Buy to Cover	$19.390	$2,250.00	$43.50	$100.00	$2,393.50	$2,786,860.50
19-Dec-13	Platinum	Sell Short	$1,328.90	80	23-Dec-13	Buy to Cover	$1,336.60	$30,800.00	$232.00	$100.00	$31,132.00	$2,755,728.50
30-Dec-13	Crude Oil	Buy	$92.96	35	31-Dec-13	Sell	$92.57	($13,650.00)	$101.50	$100.00	$13,851.50	$2,741,877.00
31-Dec-13	Australian Dollar	Buy	$0.8874	120	31-Dec-13	Sell	$0.8887	$15,600.00	$384.00	$100.00	$15,116.00	$2,756,993.00
31-Dec-13	Canadian Dollar	Buy	$0.9378	200	31-Dec-13	Sell	$0.9400	$44,000.00	$640.00	$100.00	$43,260.00	$2,800,253.00

Source: TradeStation, 2013

6.2 Performance Summary

The trade by trade details enumerated in Tables 6-1 through 6-6 enabled the synthesis of aggregate summary performance statistics over the entire data sample period from January 1, 2008 to December 31, 2013 as listed below in Table 6-7:

Table 6-7: Summary Performance Statistics

	COMBINED SET 1/1/2008 - 12/31/2013	TEST SET 1/1/2008 - 12/31/2012	LIVE SET 1/1/2013 - 12/31/2013
TOTAL TRADES	**173**	81	92
WINNING TRADES	**66**	32	34
LOSING TRADES	**107**	49	58
PERCENT PROFITABLE	**38.15%**	39.51%	36.96%
LONG TRADES	**96**	64	32
PERCENT PROFITABLE	**33.33%**	32.81%	34.38%
SHORT TRADES	**77**	17	60
PERCENT PROFITABLE	**44.16%**	64.71%	38.33%
AVERAGE TRADE NET PROFIT	**$10,406.09**	$19,268.35	$2,603.45
AVERAGE WINNING TRADE	**$102,956.52**	$131,553.75	$76,041.49
AVERAGE LOSING TRADE	**($46,681.10)**	($54,060.90)	($40,446.44)
RATIO AVERAGE WIN : AVERAGE LOSS	**2.21**	2.43	1.85
MAX CONSECUTIVE WINNING TRADES	**4**		
MAX CONSECUTIVE LOSING TRADES	**8**		
MAXIMUM TRADE DRAWDOWN	**($182,590.00)**		
MAXIMUM DRAWDOWN %	**-53.38%**		
STANDARD DEVIATION OF RETURNS	**$117,232.36**		
VALUE AT RISK	**$311,590.31**		
SKEWNESS	**3.18**		
KURTOSIS	**16.91**		
TOTAL NET PROFIT	**$1,800,253.00**		
GROSS PROFIT	**$6,795,130.50**		
GROSS LOSS	**($4,994,877.50)**		
PROFIT FACTOR	**1.36**		
TOTAL RETURN ON INITIAL CAPITAL	**180.03%**		
ANNUALIZED RATE OF RETURN	**18.72%**		

Source: TradeStation, 2013 and later amended by The Author

6.2.1 Number of Trades

As detailed in Table 6-7, the Intermarket Momentum portfolio generated 173 trades over the entire data sample period from January 1, 2008 to December 31, 2013 with the trades evenly distributed between the Test set (January 1, 2008 to December 31, 2012) and the Live set (January 1, 2013 to December 31, 2013).

Trend following momentum based strategies are dependent upon market volatility to generate the substantial price movements required to trigger trades. The relatively large number of trades experienced during the Live set is testimony to the high market volatility in 2013 resulting from the Federal Reserve's unprecedented $ 1 trillion a year quantitative easing (QE) bond buying program, the market's continuing speculation as to whether the Federal Reserve will begin to taper QE or not, and the Bank of Japan (BOJ) following the lead of their US counterparts by embarking on a similar groundbreaking $ 70 billion a month bond purchasing program in an effort to reinvigorate the Japanese economy.

The single trade outlier in the year 2009 was due to the low market volatility experienced in the aftermath of the 2008 Financial Market Crisis. Removing that single trade outlier from the analysis generated an average of 34 trades a year, or approximately 3 trades a month which is of sufficient frequency to keep the trader engaged. Prolonged flat periods out of the market, such as that experienced in 2009, severely test the discipline and patience of the trader to stay the course and remain true to the strategy.

6.2.2 Profitability

In order to be profitable, a strategy requires either a high winning percentage above 50% or a high average win to average loss ratio. The Intermarket Momentum portfolio had a low 38.15% winning percentage but the average winning trade ($ 102 956.52) was more than double the average losing trade ($ 46 681.10) resulting in its overall profitability with a 2.21 average win : average loss ratio. The portfolio also traded on both the long and the short side, with the short trades slightly more profitable (44.16%) than the long trades (33.33%).

As an indication of a strategy's robustness and ability to trade profitably in the future, there should be no significant deterioration in performance from the Test set to the Live set. The Intermarket Momentum portfolio performed remarkably well in the Live set, almost matching the Test set winning percentage whilst exceeding the Test set winning percentage on long trades, and experiencing a positive reduction in the size of the average losing trade. There was however a slight deterioration in the size of the average trade net profit, the winning percentage on short trades and the average winning trade.

6.2.3 Risk Management

To avoid the risk of ruin, the maximum drawdown (defined as the maximum peak to trough decline in trading capital measured as a percentage) should not exceed the threshold of 40% of initial capital. The Intermarket Momentum portfolio experienced a $ 533 753.50 drawdown, equivalent to 53.38% of the initial capital, within the first three quarters of the data sample period between January 1 and August 7,

2008. This drawdown suggests that a prudent level of starting capital to trade the portfolio with a trade size equal to 10% of capital, would be $ 1.5 million resulting in a much safer 36% maximum drawdown.

Unfortunately, strategies with a low winning percentage and a consequently high number of consecutive losing trades will have the disadvantage of suffering large drawdowns, therefore the prevalent need to manage this risk. Chande (2001) in his study of 80 mutual and hedge funds, found a relationship exhibited between volatility (as represented by the standard deviation of returns) and the maximum drawdown, under the assumption that more volatile fund managers produced larger drawdowns. As a rule of thumb, Chande found that three to five times the standard deviation of historical returns is an accurate predictor of the future maximum drawdown, and that at least one drawdown in the region of three to five times the standard deviation should be expected in every rolling five-year interval.

The Intermarket Momentum portfolio had a $ 117 232.36 standard deviation of returns, thereby implying a possible future maximum drawdown of approximately $ 586 000.00. This corresponds to the historical maximum drawdown of $ 533 753.50 experienced on August 7, 2008 and confirms the prudent risk management requirement of $ 1.5 million in trading capital to avoid the risk of ruin.

An additional risk management technique is the Value at Risk (VAR) measure, which indicates the maximum portfolio loss to be expected with a given level of confidence over a given time period[12]. Using the ending Intermarket Momentum Portfolio value of $ 2 800 253.00, the average daily return of 0.36%, a 95% confidence level, and the standard deviation of daily returns equal to 7.15%, the VAR is calculated to be $ 311 590.31. The VAR indicates that with a 95% level of confidence, one can expect a maximum loss of $ 311 590.31 on a given day. This translates to 11.13% of the ending portfolio value and magnifies the importance of the individual trade size risk management parameter of not exceeding 10% of capital on any individual trade.

Adhering to strict risk management guidelines is also necessary to mitigate the substantial portfolio damage that can be inflicted by surprise “Black Swan” events[13] such as the September 2001 terrorist attacks in the US, the Lehman Brothers bankruptcy in September 2008, Black Monday on October 19, 1987 and the Flash Crash of May 6, 2010. These “Black Swan” events are impossible to predict and have major impacts on stock markets and portfolios, thereby exacerbating the need for strict risk management guidelines that limit the portfolio capital exposure to any one event.

6.2.4 Kurtosis

The Intermarket Momentum portfolio exhibited a trading characteristic of multiple small losing trades interjected by infrequent large winning trades resulting in a high positive kurtosis value of 16.91, which indicates that the distribution of returns is more peaked in the center around the mean relative to a bell-shaped normal distribution. This leptokurtic property of the Intermarket Momentum portfolio is essential as it means that large positive returns occur more often than they should and explains its profitability.

[12] Source:www.investopedia.com
[13] Source: www.wikipedia.org

6.2.5 Skewness

Skewness refers to the degree of asymmetry around the mean, with a normal distribution being perfectly symmetrical and having a skewness value of zero. The Intermarket Momentum portfolio returns exhibited a positive skewness of 3.18 which indicates an asymmetric longer or fatter tail to the right of the mean and signifies that returns are more skewed toward positive values, a vital property for a profitable strategy.

6.2.6 Return

The profit factor is measured by dividing the gross profit by the gross loss and is defined as the amount of profit per unit of risk, with values greater than one indicating a profitable system. Importantly, the Intermarket Momentum portfolio had a profit factor of 1.36 and generated a total net profit over the entire data sample period of $ 1 800 253.00.

The total return on the initial portfolio capital of $ 1 million was 180.03% which translated into a respectable annualized return of 18.72%.

6.3 Comparative Total Return Analysis

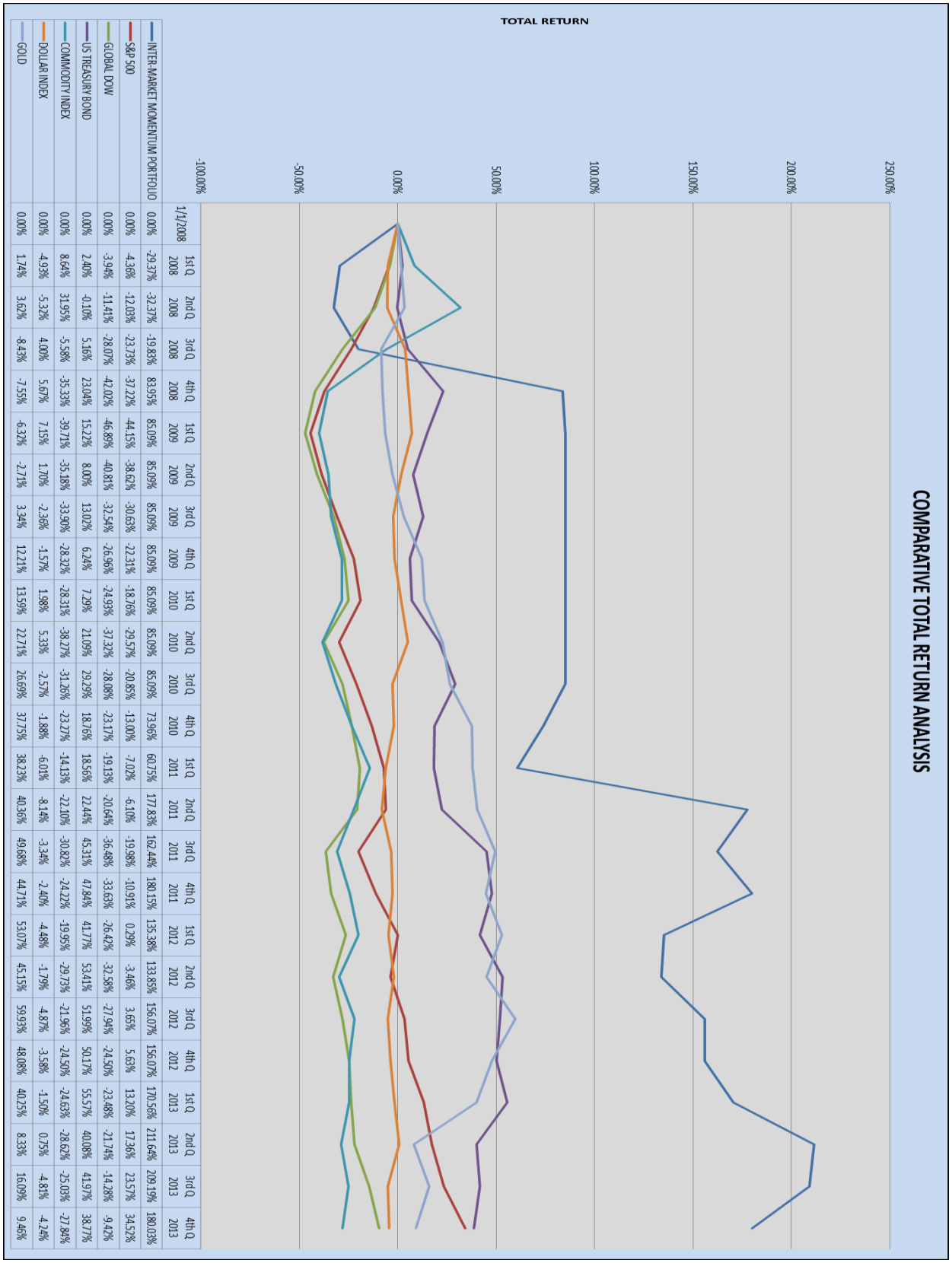
Figure 6-1 over-page graphs the total return on initial capital of the Intermarket Momentum portfolio over the entire data sample period from January 1, 2008 to December 31, 2013 relative to the total return earned as of January 1, 2008 by the major asset classes – Stocks (as represented by the S&P 500 stock index and the Global Dow international stock index); Bonds (represented by the 30 year US Treasury Bond); Commodities (represented by the S&P Goldman Sachs Commodity Index and Gold); and Currencies (as represented by the Dollar Index).

Although the Intermarket Momentum portfolio initially underperformed the other major asset classes during the first three quarters of the data sample period where it also suffered its maximum drawdown, Figure 6-1 clearly depicts how it outperformed all the other major asset classes thereafter.

By comparison, at the end of the sample period the Intermarket Momentum portfolio had returned 180.03% relative to:

- The US Treasury Bond (38.77%)
- S&P 500 (34.52%)
- Gold (9.46%)
- The Dollar Index (-4.24%)
- The Global Dow (-9.42%) and
- The S&P Goldman Sachs Commodity Index (-27.85%).

Figure 6-1: Comparative Total Return Analysis



	1/1/2008	1st Q 2008	2nd Q 2008	3rd Q 2008	4th Q 2008	1st Q 2009	2nd Q 2009	3rd Q 2009	4th Q 2009	1st Q 2010	2nd Q 2010	3rd Q 2010	4th Q 2010	1st Q 2011	2nd Q 2011	3rd Q 2011	4th Q 2011	1st Q 2012	2nd Q 2012	3rd Q 2012	4th Q 2012	1st Q 2013	2nd Q 2013	3rd Q 2013	4th Q 2013
INTER-MARKET MOMENTUM PORTFOLIO	0.00%	-29.37%	-32.37%	-19.83%	83.95%	85.09%	85.09%	85.09%	85.09%	85.09%	85.09%	85.09%	73.96%	60.75%	177.83%	162.44%	180.15%	135.38%	133.85%	156.07%	156.07%	170.56%	211.64%	209.19%	180.03%
S&P 500	0.00%	-4.36%	-12.03%	-23.73%	-37.22%	-44.15%	-38.62%	-30.63%	-22.31%	-18.76%	-29.57%	-20.85%	-13.00%	-7.02%	-6.10%	-19.98%	-10.91%	0.29%	-3.46%	3.65%	5.63%	13.20%	17.36%	23.57%	34.52%
GLOBAL DOW	0.00%	-3.94%	-11.41%	-28.07%	-42.02%	-46.89%	-40.81%	-32.54%	-26.96%	-24.93%	-37.32%	-28.08%	-23.17%	-19.13%	-20.64%	-36.48%	-33.63%	-26.42%	-32.58%	-27.94%	-24.50%	-23.48%	-21.74%	-14.28%	-9.42%
US TREASURY BOND	0.00%	2.40%	-0.10%	5.16%	23.04%	15.22%	8.00%	13.02%	6.24%	7.29%	21.09%	29.29%	18.76%	18.56%	22.44%	45.31%	47.84%	41.77%	53.41%	51.99%	50.17%	55.57%	40.08%	41.97%	38.77%
COMMODITY INDEX	0.00%	8.64%	31.95%	-5.58%	-35.33%	-39.71%	-35.18%	-33.90%	-28.32%	-28.31%	-38.27%	-31.26%	-23.27%	-14.13%	-22.10%	-30.82%	-24.22%	-19.95%	-29.73%	-21.96%	-24.50%	-24.63%	-28.62%	-25.03%	-27.84%
DOLLAR INDEX	0.00%	-4.93%	-5.32%	4.00%	5.67%	7.15%	1.70%	-2.36%	-1.57%	1.98%	5.33%	-2.57%	-1.88%	-6.01%	-8.14%	-3.34%	-2.40%	-4.48%	-1.79%	-4.87%	-3.58%	-1.50%	0.75%	-4.81%	-4.24%
GOLD	0.00%	1.74%	3.62%	-8.43%	-7.55%	-6.32%	-2.71%	3.34%	12.21%	13.59%	22.71%	26.69%	37.75%	38.23%	40.36%	49.68%	44.71%	53.07%	45.15%	59.93%	48.08%	40.25%	8.33%	16.09%	9.46%

6.4 Jensen's Alpha

Following Jensen (1967) and Malkiel (1995), the risk-adjusted portfolio excess performance can be measured through the traditional CAPM model:

$$R_{IP} - R_F = \alpha + \beta\,(R_{MKT} - R_F) + \varepsilon \qquad (6.1)$$

where:

6.4.1 R_{IP}

R_{IP} is the return on the Intermarket Momentum Portfolio and measured by average quarterly returns as listed over-page in Figure 6-2.

R_{IP} is therefore equal to 7.46%.

6.4.2 R_{MKT}

R_{MKT} is the return on the market benchmark represented by the S&P 500 Stock Index (SP) and measured by average quarterly returns as listed over-page in Figure 6-2.

The S&P 500 Stock Index is globally the most liquid and highly traded stock market and therefore is the universal benchmark utilized to represent the market return and provide a basis of comparison in performance studies.

R_{MKT} is therefore equal to 1.47%.

6.4.3 R_F

R_F is the risk-free rate of return and represents the level of interest an investor would expect from a risk-free investment over a given period of time[14]. Due to a lack of consensus as to its interpretation and measurement, the rate of return on a US Government Treasury Bond is the industry standard as a proxy for the risk-free rate as the risk of default is practically negligible.

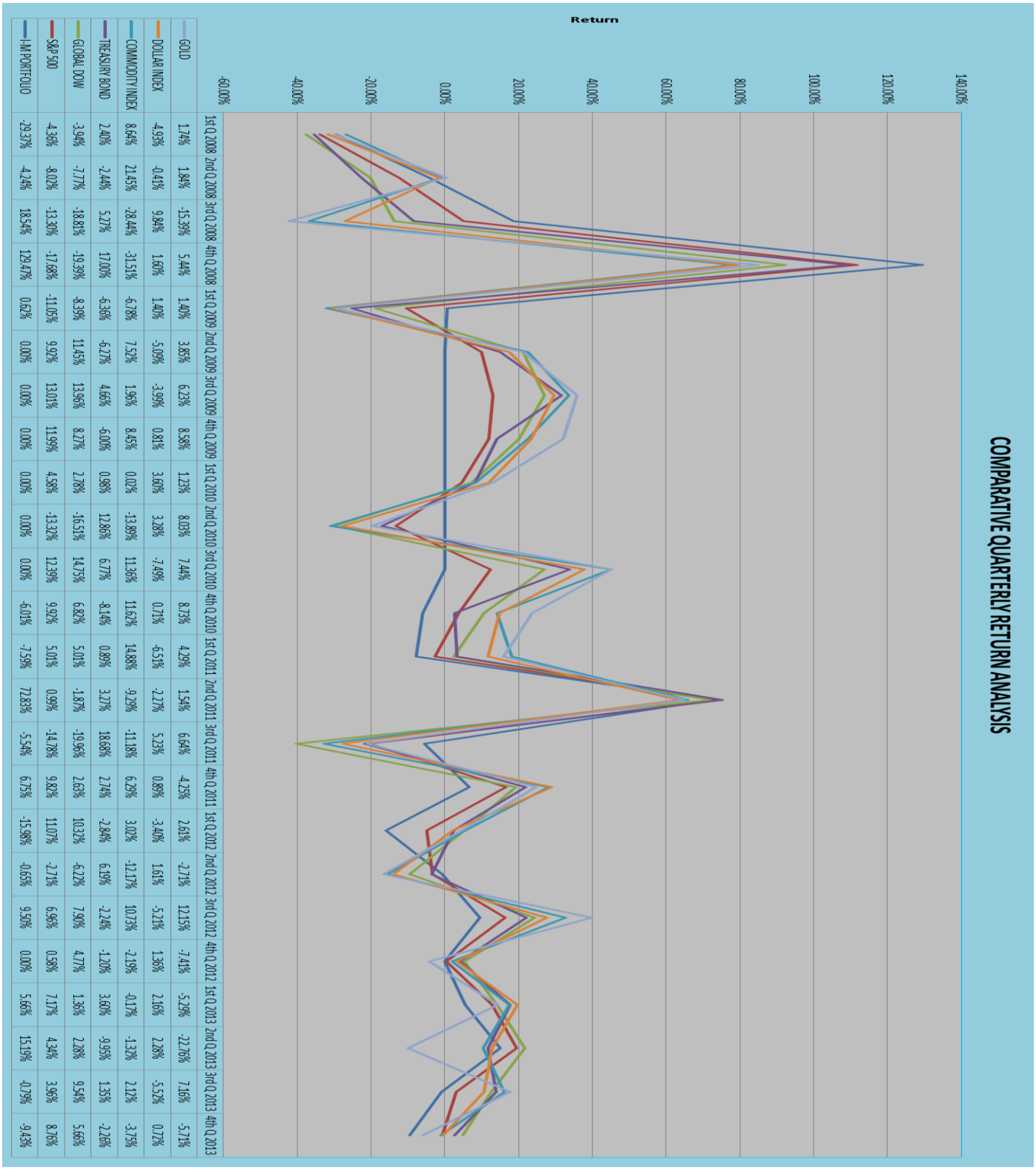
Following Malkiel (1995), the risk-free rate of return is represented by the average 3 month US Treasury Bill yield[15] over the data sample period. Historical Treasury Bill interest rate statistics may be retrieved from the data and charts center of the US Department of the Treasury website: www.treasury.gov

R_F is therefore calculated as 0.32%

[14] Source: http://www.wikipedia.org

[15] Source: http://www.treasury.gov/resource-center/data-chart-center/interest-rates

Figure 6-2: Comparative Quarterly Return Analysis



	GOLD	DOLLAR INDEX	COMMODITY INDEX	TREASURY BOND	GLOBAL DOW	S&P 500	I-M PORTFOLIO
1st Q 2008	1.74%	-4.93%	8.64%	2.40%	-3.94%	-4.36%	-29.37%
2nd Q 2008	1.84%	-0.41%	21.45%	-2.44%	-7.77%	-8.02%	-4.24%
3rd Q 2008	-15.39%	9.84%	-28.44%	5.27%	-18.81%	-13.30%	18.54%
4th Q 2008	5.44%	1.60%	-31.51%	17.00%	-19.39%	-17.68%	129.47%
1st Q 2009	1.40%	1.40%	-6.78%	-6.36%	-8.39%	-11.05%	0.62%
2nd Q 2009	3.85%	-5.09%	7.52%	-6.27%	11.45%	9.92%	0.00%
3rd Q 2009	6.23%	-3.99%	1.96%	4.66%	13.96%	13.01%	0.00%
4th Q 2009	8.58%	0.81%	8.45%	-6.00%	8.27%	11.99%	0.00%
1st Q 2010	1.23%	3.60%	0.02%	0.98%	2.78%	4.58%	0.00%
2nd Q 2010	8.03%	3.28%	-13.89%	12.86%	-16.51%	-13.32%	0.00%
3rd Q 2010	7.44%	-7.49%	11.36%	6.77%	14.75%	12.39%	0.00%
4th Q 2010	8.73%	0.71%	11.62%	-8.14%	6.82%	9.92%	-6.01%
1st Q 2011	4.29%	-6.51%	14.88%	0.89%	5.01%	5.01%	-7.59%
2nd Q 2011	1.54%	-2.27%	-9.29%	3.27%	-1.87%	0.99%	72.83%
3rd Q 2011	6.64%	5.23%	-11.18%	18.68%	-19.96%	-14.78%	-5.54%
4th Q 2011	-4.25%	0.89%	6.29%	2.74%	2.63%	9.82%	6.75%
1st Q 2012	2.61%	-3.40%	3.02%	-2.84%	10.32%	11.07%	-15.98%
2nd Q 2012	-2.71%	1.61%	-12.17%	6.19%	-6.22%	-2.71%	-0.65%
3rd Q 2012	12.15%	-5.21%	10.73%	-2.24%	7.90%	6.96%	9.50%
4th Q 2012	-7.41%	1.36%	-2.19%	-1.20%	4.77%	0.58%	0.00%
1st Q 2013	-5.29%	2.16%	-0.17%	3.60%	1.36%	7.17%	5.66%
2nd Q 2013	-22.76%	2.28%	-1.32%	-9.95%	2.28%	4.34%	15.19%
3rd Q 2013	7.16%	-5.52%	2.12%	1.35%	9.54%	3.96%	-0.79%
4th Q 2013	-5.71%	0.72%	-3.75%	-2.26%	5.66%	8.76%	-9.43%

Source: TradeStation, 2013 and later amended by The Author

6.4.4 β

$\boldsymbol{\beta}$ is the Intermarket Momentum Portfolio Beta which measures the volatility of the portfolio relative to the market as a whole and describes the systematic risk of the portfolio. Beta is calculated as:

$$\boldsymbol{\beta} = \frac{Covariance(R_{IP}, R_{MKT})}{Variance(R_{MKT})} \qquad \textbf{(6.2)}$$

therefore,

$$\boldsymbol{\beta} = \frac{-0.0108699}{0.0091132}$$

and,

$\boldsymbol{\beta}$ **= -1.19**

6.4.5 ε

ε is the random error term.

As detailed by Jensen (1967), $\boldsymbol{\beta}$ will only be an efficient estimate of the systematic risk if the random error term has an expected value of zero: $E(\varepsilon_t)$**= 0,** and is uncorrelated to the market.

If a manager has superior forecasting ability, he will tend to select stocks that result in : $\varepsilon_t > 0$**,** and his portfolio will earn returns in excess of the normal risk premium. Allowance is made for this forecasting ability by assuming the expected value of the random error term to be zero: $E(\varepsilon_t)$**= 0,** in addition to its non-correlation to the market. The estimated regression is now no longer constrained to pass through the origin, and the intercept now represents the forecasting ability and performance of the manager (Jensen, 1967).

6.4.6 Alpha (α)

α is the intercept and designates Jensen's Alpha[16], simply abbreviated as Alpha. A positive Alpha (**α**) implies risk-adjusted performance in excess of the market that can be attributed to the portfolio manager. A naïve buy-and-hold policy can be expected to yield an Alpha (**α**) of zero and a manager underperforming the market will yield a negative Alpha (**α**).

[16] The eponymous Jensen's Alpha was first used as a measure of mutual fund performance by Harvard Business School professor Michael Jensen in 1967.

6.4.7 Calculating Alpha

$$R_{IP} - R_F = \alpha + \beta\,(R_{MKT} - R_F) + \varepsilon \qquad (6.3)$$

therefore,

$$\alpha = (R_{IP} - R_F) - \beta\,(R_{MKT} - R_F) + \varepsilon$$

$$\alpha = (7.46\% - 0.32\%) - (-1.19)\,(1.47\% - 0.32\%)) + \varepsilon$$

and,

$$\alpha = 8.52\%$$

6.5 Test of Significance

Testing the statistical significance of Jensen's Alpha resulted in the following data analyses:

6.5.1 Time Series Price Data

The time series price data for the Intermarket Momentum Portfolio was generated by the Trades List tables which showed the cumulative Portfolio Balance at each trade exit date.

The intra-day 240-minute time series data for the market benchmark S&P 500 Index at the trade exit dates was generated by the TradeStation historical database.

6.5.2 Actual Daily Return Time Series

The actual daily return time series for the Intermarket Momentum Portfolio and the market benchmark S&P 500 Index were extracted from the price series data by taking the natural logarithm of the ratio of successive prices:

$$\ln \frac{Price_t}{Price_{t-1}} \qquad (6.4)$$

6.5.3 Initial Estimated Returns

Assuming a constant dummy value of 0.5% for the daily alpha, initial estimated returns for the Intermarket Momentum Portfolio were calculated utilizing the following equation:

$$R_{IP} = \alpha + R_F + \beta[R_{MKT} - R_F] \qquad (6.5)$$

where,

$\boldsymbol{R_{IP}}$ = Daily Intermarket Momentum Portfolio Estimated Return

$\boldsymbol{\alpha}$ = Daily dummy Alpha = 0.5%

$\boldsymbol{R_F}$ = Daily Risk Free Rate of Return, where the average 3 month US Treasury Bill yield[17] over the data sample period of 0.32% is converted into a daily rate by the following formula:

$(\mathbf{1} + \mathbf{0.32}\%)^{\frac{\mathbf{1}}{\mathbf{90}}} - \mathbf{1}$ ***therefore,***

$\boldsymbol{R_F} = 0.0035\%$

$\boldsymbol{\beta}$ is the Intermarket Momentum Portfolio Beta which measures the volatility of the portfolio relative to the market as a whole and describes the systematic risk of the portfolio. Beta is calculated utilizing the actual daily return time series for the Intermarket Momentum Portfolio and the market benchmark S&P 500 Index as follows:

$$\boldsymbol{\beta} = \frac{\boldsymbol{Covariance}(\boldsymbol{R_{IP}}, \boldsymbol{R_{MKT}})}{\boldsymbol{Variance}(\boldsymbol{R_{MKT}})}$$

therefore,

$$\boldsymbol{\beta} = \frac{\mathbf{-0.00040112}}{\mathbf{0.00189922}}$$

and,

$\boldsymbol{\beta}$ **= -0.21**

$\boldsymbol{R_{MKT}}$ = Actual Daily Return Time Series for the market benchmark S&P 500 Index.

6.5.4 Sum of Squared Differences

At each data point, the squared difference between the actual returns and initial estimated returns of the Intermarket Momentum Portfolio are calculated according to the following formula:

$$\boldsymbol{Squared\ Difference} = (\boldsymbol{Actual\ Return} - \boldsymbol{Estimated\ Return})^2 \qquad \textbf{(6.6)}$$

The sum of the squared differences across all data points is then calculated.

6.5.5 Alpha Estimated Using the Least Squares Method (LSM)

Excel's Solver function then utilizes LSM to estimate the Daily Alpha by minimizing the sum of squared differences via a change in the Daily Estimated Alpha.

[17] Source: http://www.treasury.gov/resource-center/data-chart-center/interest-rates

The Solver function converged to a solution by minimizing the sum of squared differences, resulting in a Daily Estimated Alpha = 0.67% and thereby generating a new time series of estimated returns for the Intermarket Momentum Portfolio.

The Daily Estimated Alpha is converted into an Annualized Estimated Alpha (α) by the following formula:

$$\boldsymbol{Annualized\ Estimated\ Alpha} = (\mathbf{1} + \boldsymbol{Daily\ Estimated\ Alpha})^{\mathbf{252}} - \mathbf{1} \qquad \textbf{(6.7)}$$

$$\boldsymbol{Annualized\ Estimated\ \alpha} = (\mathbf{1} + \mathbf{0.67\%})^{\mathbf{252}} - \mathbf{1}$$

$$\boldsymbol{Annualized\ Estimated\ \alpha} = \mathbf{438.26\%}$$

6.5.6 Statistical Significance Test of Alpha

The ratio of the Annualized Estimated Alpha to the Annualized Standard Error of the Regression is known as the t-statistic. If the absolute value of the t-statistic > 1.96 (the critical value of the t-statistic at the 5% significance level), then it may be concluded that Alpha is different from zero and that it is statistically significant, therefore

$$\boldsymbol{t - statistic} = {}^{\boldsymbol{Annualized\ Estimated\ Alpha}}/_{\boldsymbol{Annualized\ Standard\ Error}} \qquad \textbf{(6.8)}$$

where,

$$\boldsymbol{Annualized\ Estimated\ Alpha}\ (\boldsymbol{\alpha}) = \mathbf{438.26\%}$$

and

$$\boldsymbol{Annualized\ Standard\ Error} = \boldsymbol{Daily\ Volatility\ x}\sqrt{\mathbf{252}}$$

where,

$$\boldsymbol{Daily\ Volatility} = \boldsymbol{Standard\ Deviation}\ (\boldsymbol{Actual - Estimated\ Returns}),$$ therefore

$$\boldsymbol{Daily\ Volatility} = \mathbf{7.0873\%}$$ and

$$\boldsymbol{Annualized\ Standard\ Error} = \mathbf{7.0873\%}\ \boldsymbol{x}\sqrt{\mathbf{252}}$$

$$\boldsymbol{Annualized\ Standard\ Error} = \mathbf{112.51\%}$$

The absolute value of the t-statistic was therefore calculated as follows:

$$\boldsymbol{t - statistic} = {}^{\boldsymbol{Annualized\ Estimated\ Alpha}}/_{\boldsymbol{Annualized\ Standard\ Error}} \qquad \textbf{(6.9)}$$

$$\boldsymbol{t - statistic} = {}^{\mathbf{438.26\%}}/_{\mathbf{112.51\%}}$$

$$\boldsymbol{t - statistic} = \mathbf{3.90}$$

$t - statistic = 3.90 > 1.96$ (the critical value of the t-statistic at the 5% significance level), therefore it may be concluded that the Intermarket Momentum Portfolio Alpha is different from zero and that it is statistically significant at the 5% level.

6.6 Hypothesis Testing

6.6.1 The Null Hypothesis

The Null Hypothesis supports the Weak-Form EMH by stating, given all publicly available historical information, that an alpha less than or equal to zero indicates a portfolio of Intermarket strategies cannot generate returns in excess of the market, thereby implying that the developed country capital markets are Weak-Form efficient:

$\boldsymbol{H_0 : \alpha \leq 0}$

6.6.2 The Alternative Hypothesis

The Alternative Hypothesis states that a significantly positive Alpha α indicates risk-adjusted performance in excess of the market which implies that the developed country capital markets are not Weak-Form efficient:

$\boldsymbol{H_1 : \alpha > 0}$

The positive Alpha of 8.52% is > 0 and significant at the 5% level (t-statistic of 3.90 > the 1.96 critical value). This indicates that the positive Alpha generated by the Intermarket Momentum Portfolio is unlikely to have occurred by chance alone and that there is less than a 5% probability of erroneously rejecting the Null Hypothesis.

This allows the rejection of the Null Hypothesis and the acceptance of the Alternative Hypothesis that the developed country capital markets are not Weak-Form efficient.

6.7 Summary

The trade by trade details generated by the TradeStation strategy performance reports enabled the synthesis of aggregate summary performance statistics over the entire data sample period from January 1, 2008 to December 31, 2013.

This allowed the calculation and test of significance of the Alpha generated by the portfolio of Intermarket Momentum trading strategies and the consequent testing of the Null Hypothesis.

The conclusions based on these results are presented next in Chapter 7.

7 CONCLUSIONS AND RECOMMENDATIONS

The results show that the portfolio of Intermarket Momentum trading strategies generated returns in excess of the market with a significantly positive Alpha of 8.52% that allowed the rejection of the Null Hypothesis and the acceptance of the Alternative Hypothesis that the developed country capital markets are not Weak-Form efficient, thereby refuting the widely accepted EMH.

This outperformance utilizing simple technical analysis rules formulated literally decades ago answered the research question as to why the majority of investment fund managers stubbornly persist in utilizing the apparently worthless endeavor of technical analysis and why investment banks and mutual funds continue to pay their fund managers multi-million-dollar compensation packages to pursue the practice of technical analysis in their trading strategies.

The study results also solved the research problem by eliminating the methodological weaknesses in prior academic EMH studies which severely handicapped the profit generating potential of technical analysis and resulted in the erroneous acceptance of the Null Weak-Form market efficiency hypothesis.

The research objective of utilizing high frequency intra-day data, the combination of qualitative and quantitative techniques and volume signals to develop Intermarket Momentum technical analysis strategies that generate significant excess profits and consequently show that contrary to prior research findings, the developed country capital markets are not Weak-Form efficient, was thus also achieved.

Importantly, the data period from January 1, 2008 to December 31, 2013 also encompassed the unprecedented bear market of 2008 resulting from the world financial crisis (the S&P 500 crashed -58.8% during this period), and the 2009 – 2013 central bank liquidity-fueled bull market that followed the market bottom in March 2009 where the S&P 500 rallied 207.3%. These extreme bull and bear market cycles imbedded in the six-year study data period presented a stern test of the robustness and ability of the Intermarket Momentum trading strategies to generate returns in excess of the market and thereby refute the EMH. Additionally, this variety of market environments enhanced the applicability of the results to diverse market conditions.

7.1 Significance of the Results

The study results show that the developed country capital markets are not Weak-Form efficient and this is significant on a number of levels:

7.1.1 Modern Finance Theory

The building blocks of the Modern Finance Theory paradigm created over the past 50 years are the EMH (which states that prices fully reflect all available information and that the markets are an efficient mechanism in driving prices to their intrinsic equilibrium levels), the CAPM - Capital Asset Pricing Model

(which describes the relationship between the risk and return of capital assets, in that the return of an asset is determined by its sensitivity to non-diversifiable systematic market risk over and above the risk-free rate, and consequently that a portfolio of non-correlated assets could diversify away all firm-specific risk), the M&M – Modigliani-Miller theorem (which states that under certain assumptions, the level of leverage has no effect on the firms value), and the Black-Scholes-Merton option pricing model (which shows that it is possible to construct a riskless portfolio through the dynamic hedging strategy of taking positions in cash, options and the underlying security). The EMH is the cornerstone of Modern Finance Theory and the underlying assumption upon which all the theories are based (Caldentey and Vernengo, 2010).

Caldentey and Vernengo (2010); Moosa, (2010); and Volcker (2011) also opine that faith in the EMH and Modern Finance Theory led to a deregulation of the financial markets and a global explosion in the financial services industry based on the development of diversified portfolio investment vehicles and option / derivative based investment products.

As a result of this success, the unrealistic assumptions and empirical weakness of the core Modern Finance theories were viewed as acceptable anomalies (Frankfurter, 2007). However, the apparent failure of Modern Finance Theory during the recent 2008 Global Financial crisis has now brought its validity into the forefront and raised the question as to whether Behavioral Finance, which attempts to explain market efficiency anomalies in terms of investor behavior and cognitive biases such as over-reaction, under-reaction, overconfidence and loss aversion, has now replaced EMH as the predominant theory of financial markets (Ball, 2009).

Ball (2009: 15) however argues that “it takes a theory to beat a theory” and since behavioral finance has no anomalies of its own, it is simply a set of disjointed ideas that attempt *ex post* to explain EMH anomalies and is therefore not a theory. Malkiel (2011: 53) also dealt a blow to Behavioral Finance (BF) by noting that “BF does not argue that the behavioral biases of investors make the market beatable”. Ball (2009: 16) concludes therefore that in the absence of a practical alternative the EMH is “efficient enough” and will continue to be durable in the future.

Despite its theoretical weakness, the EMH survives on the practical application of the hypothesis that no market participant should be able to consistently generate excess returns and the lack of empirical evidence to the contrary. Significant evidence against Weak-Form capital market efficiency via consistently profitable technical trading strategies will drive a stake through the EMH by additionally rendering the EMH nugatory from a practical point of view. This would encourage future research in Behavioral Finance and strengthen the case for a paradigm shift in price formation theory.

7.1.2 Bank Regulation

Critics (Fox, 2009; Lowenstein, 2009; Moosa, 2010; Caldentey and Vernengo, 2010; and Volcker 2011) have blamed the recent 2008 financial crisis on an unjustified faith in efficient markets and the ability of market forces to regulate prices and risk that led to *laissez faire* capitalism and the deregulation of the banking industry in the 1990’s.

Volcker (2011) additionally attributes the deregulation of the banking sector to the explosive growth of a shadow banking system – hedge funds, money market funds and other unregulated entities – that developed toxic and opaque Collateralized Debt Obligation (CDO) investment instruments, and to the build-up in massive levels of leverage undertaken by financial institutions in their greed to invest in these (at the time) lucrative investment vehicles. However, the bursting of the housing bubble led to the unexpected mass default of the risky sub-prime mortgages underlying the CDO's, and left the world's banking system on the brink of collapse.

In response to the financial crisis and in an effort to prevent another crisis and resultant government bailout, the US Congress passed the controversial Dodd-Frank Wall Street Reform Act in 2010, and concurrently the international Basel III Accord was also passed which introduced new stringent global regulatory standards on bank capital, liquidity and leverage requirements (Tropeano, 2011).

The leaders of most global banking institutions, the most vocal being JP Morgan CEO Jamie Dimon, have harshly criticized the Dodd-Frank and Basel III reforms, asserting that the reforms have not only increased uncertainty and stifled bank lending and innovation, but are also ultimately responsible for the slow economic recovery since the financial crisis (Gao, 2011).

Empirical evidence of market efficiency (or inefficiency) will play a major role in this ongoing debate between government bureaucrats and banking industry leaders regarding the necessary level of banking industry regulation and its overall significant effect on the economy.

7.1.3 Allocation of Resources

As noted by Fama (1970:383), "the primary role of the capital market is allocation of ownership of the economy's capital stock." However, the optimal allocation of the economy's capital stock can only occur in an efficient market where prices fully reflect all available information and send accurate signals to private and institutional investors regarding their capital investment decisions amongst the nation's private and public companies, and ensure that firms receive accurate price signals to guide their strategic production and investment decisions.

Efficient capital markets ensure that investors purchase shares in firms that are more productive thereby offering higher returns, and allow firms to acquire capital at a cost that is commensurate with the riskiness of those firms. This results in stock market growth which feeds into economic growth (McGowan, 2011).

An inefficient capital market will result in the sub-optimal allocation of the nation's resources which will have a significant detrimental long term effect on economic growth and prosperity.

7.1.4 Long-Term Investment Strategy

The life expectancy in developed countries is expected to rise by two years every decade due to improvements in medical science and hospital care, healthier nutritional choices, active lifestyles which include more physical exercise, and a drastic reduction in smoking (Roxby, 2011).

For young adults, this imparts an enormous significance to investment choices in building a retirement portfolio that can realistically be required to support retirees for 30 years beyond the retirement age of 65. Investment choices also need to be designed to accommodate the likelihood of prolonged bear market periods and unpredictable market crashes.

If the global capital markets are shown to be efficient, then the prudent investment choice would be to avoid high cost mutual and hedge funds as they will not be able to generate returns in excess of the market or a naïve buy-and-hold strategy. In fact, many funds will underperform the market even gross of the high upfront fees and commissions. In the case of investment funds, you get what you don't pay for - in other words, try and avoid upfront fees because they erode away any potential excess return generated by the fund. In a scenario of efficient global capital markets, the optimal investment choice would simply be a low cost, passive Index fund that tracks the market.

If the global capital markets are shown to be inefficient, then it would be a wise choice to select a professional investment manager that is able to capitalize on global market inefficiencies by diversifying and trading internationally. Investing is a skill and those managers that consistently demonstrate the ability to earn returns in excess of the market deserve to be adequately rewarded by performance based fees for generating alpha[18] and a much needed larger nest egg upon retirement for their clients.

7.1.5 Business Leadership

The EMH as the cornerstone of Modern Finance Theory and technical analysis as an intensively and widely used investment analysis technique, together constitute vital elements of Financial Management which remains a core foundation course of all Master of Business Administration (MBA) programs[19]. In addition, top business schools place more than 40% of their MBA graduates in the finance industry – former Merrill Lynch CEO's John Thain and Stanley O'Neal, Lehman Brothers CEO Richard Fuld, and *ex* Citigroup CEO Vikram Pandit are all card-carrying MBA graduates (Holland, 2009).

The banking and investment banking industry are the lifeblood of an economy, the failure of which would pose a systemic risk to which the 2008 world financial crisis bears testimony. Not surprisingly, financial industry executives are the preeminent business leaders in our society responsible for guiding the economy through a constantly changing global business environment.

7.2 Recommendations for Future Research

Following on one of the premises of this study which utilized high frequency intra-day data, significant advancements in computer technology and high speed data communications have stimulated a new trading niche known as high frequency algorithmic trading, whose algorithms detect pricing inefficiencies

[18] Alpha is defined as a measure of the risk-adjusted return on an investment in excess of the commensurate risk, and is thus the return that can be attributable to the investment manager skill.
[19] Source: www.wikipedia.org

at a millisecond level and generate millions of trades per day with the objective of simply earning one cent profit per trade.

Anecdotal evidence indicates that over the past 18 months, a number of these high frequency algorithmic trading firms have yet to experience a losing month and have consistently outperformed the market.

Cliff and Northrup (2012) examined the role played by high speed algorithmic trading in the May 6, 2010 Flash Crash where in the space of one hour, the Dow crashed 1000 points and then miraculously recovered narrowly avoiding a global market sell-off contagion. This unprecedented market volatility was due to the simultaneous large order executions by high speed algorithms, or as described by Cliff and Northrup (2012: 23) "a sudden and dramatic failure in an ultra-large-scale software-intensive socio-technical system (the US financial markets)". They propose an investment intensive, global scale simulation model initiative as one approach for assessing and controlling systemic risk in the financial markets, in addition to calling for further research to develop appropriate tools for the management of reliable ultra-large-scale complex socio-technical systems resulting from technological advancement and the role played by high speed algorithmic trading.

Future research is therefore necessary to determine the impact of high speed algorithmic trading on not only the EMH and price formation theory, but also market volatility and liquidity.

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9 GLOSSARY OF TERMS

Advanced Emerging Market: Under the FTSE definition, advanced emerging markets are classified as upper or lower middle Gross National Income countries with advanced market infrastructures.

Alexandrian Filter Rules: Trend following trading range breakout filter rule developed by Sydney Alexander in 1961.

Alpha: Alpha is defined as a measure of the risk-adjusted return on an investment in excess of the commensurate risk, and is thus the return that can be attributable to the investment manager skill.

Bank of Japan: The Central Bank of Japan

BOJ: Abbreviation for the Bank of Japan

Bond: Fixed Income Security issued by a company (Corporate Bond) or government (Government or Treasury Bond) that borrows the funds for a defined period of time at a fixed interest rate (coupon).

Bourse: Stock market in a non-English speaking country, specifically France.

BOVESPA: Index of 50 stocks trading in Brazil on the Sao Paulo Stock, Mercantile and Futures Exchange.

BRIC: Acronym representing the emerging markets of Brazil, Russia, India and China.

Broker Commission: Stock broker commission charged per trade to place and execute buy and sell orders.

BSE-100 Index: Index of the top 100 large cap stocks trading in India on the Bombay Stock Exchange.

Buy-and-hold: Naïve investment strategy where the investor buys stocks and holds them for an indefinite period of time.

Buy to cover: Buy order on a stock that closes out an existing short position.

Candlestick: Style of bar chart where the body of the candle and upper and lower wick describe the opening, closing, high, low and price direction during a time period.

CAPM: The Capital Asset Pricing Model – describes the relationship between risk and expected return of securities.

CBOE: Chicago Board Options Exchange.

Close: The final price at which a security is traded in a given time period.

CMT: Chartered Market Technician – professional designation awarded by the Market Technicians Association (MTA) that confirms proficiency in technical analysis.

Collateralized Debt Obligation (CDO): Structured security backed by a pool of bonds, loans, and other assets.

Commission: See broker commission

Commodity: Basic good used in commerce as an input in the production of goods and services.

Commodity Index: Index that tracks a basket of commodities to measure their performance.

Commodity Currencies: Currencies of countries whose economies depend heavily upon the export of raw materials.

Correlation: Mutual relationship or connection between two or more variables.

Covariance: Measure of the degree to which returns on two risky assets move in tandem.

Currency: Generally accepted medium of exchange in use in a country and issued by a government.

Depression: Severe and prolonged downturn in economic activity.

Developed Market: High income country that is most developed in terms of its economy and capital markets, and includes ease of capital movement, and efficiency of market institutions.

DJIA: Dow Jones Industrial Average – index of 30 significant blue chip stocks traded on the New York Stock Exchange.

DMI: Directional Movement Index – an indicator developed to identify a definable trend.

Drawdown: The peak to trough decline during a specific period of an investment.

Dollar Index: Measure of the value of the US Dollar relative to a basket of six major foreign currencies: Canadian Dollar, British Pound, Euro, Swiss Franc, Swedish Krone, and the Japanese Yen.

Dow: See Dow Jones Industrial Average.

EIA: U.S. Energy Information Administration.

EMA: Exponential Moving Average – moving average where more weight is allocated to the latest data.

Eurodollar: U.S. Dollar denominated deposits held in banks outside of the United States.

ex ante: Beforehand, or before the event – term that refers to future events.

ex post: After the fact.

"Fair Game": The expected return of a security at time t+1 based on the current information set at time t, is equal to zero.

Federal Reserve: Central Bank of the United States, often referred to as the "Fed".

Federal Funds Rate: Interest rate at which banks trade funds maintained at the Federal Reserve (known as federal funds) overnight with each other.

Forex: The market in which currencies are traded.

Frontier Emerging Market: Frontier Emerging markets have a lower market capitalization and liquidity than the more developed traditional emerging markets.

Fundamental Analysis: Method that analyzes the financial statements of a business in order to predict its intrinsic value under the premise that the market price of an asset will eventually tend to move toward its true intrinsic value.

Futures: Financial contract obligating the buyer to purchase an asset (or the seller to sell an asset) at a predetermined future date and price.

GDP: Gross Domestic Product - monetary value of all final goods and services produced within a country's borders within a specific time period, usually one year.

Global Dow: An index of 150 international blue chip stocks selected by senior editors of the Wall Street Journal.

Gold: As one of the precious metal commodities, Gold derives its value from not only its industrial use in jewelry and electronics, but also as a hedge against inflation and a store of value in times of economic and political uncertainty.

Hang Seng: The Hang Seng Index (HSI) is a market capitalization weighted index of the 40 largest companies that trade on the Hong Kong Exchange.

High: The highest price traded by a stock within a specific time period.

i.e.: Abbreviation of the Latin term *id est* which basically means "that is".

Index (plural: Indices): Portfolio of securities representing a particular market or portion of it.

Interest Rate: Interest earned on trading capital while not actively in a trade.

Intermarket Analysis: The analysis of one or more related markets (inter-markets) in order to determine the strength or weakness of the market being considered (traded market).

Intrinsic Value: Present value of all expected future net cash flows to the company.

Jensen's Alpha: Risk-adjusted performance measure that represents the average return on a portfolio in excess of the return predicted by the CAPM, given the portfolio's beta and the average market return.

JSE: Johannesburg Stock Exchange.

KOSPI: Korean Composite Stock Price Index.

Law of Large Numbers: Statistical principle which states that as the sample size increases, the mean of the sample will approach the average of the population.

Long Position: The buying of a stock, commodity or currency with the expectation that it will rise in value.

Low: The lowest price traded by a stock within a specific time period.

MACD: Moving Average Convergence Divergence – trend following indicator that is calculated by subtracting the 26 day exponential moving average (EMA) from the 12 day EMA.

Martingale: Stochastic process whereby the best prediction of a future price is the current price.

MBA: Master of Business Administration.

MOM: Momentum Indicator – trend following indicator that shows the difference between today's closing price and the closing price *n* days ago.

Moving Average: The *n* day moving average is a simple rolling average of the past *n* days of prices.

MSCI: Morgan Stanley Capital International – each MSCI Index measures a different aspect of global stock market performance.

MTA: Market Technicians Association.

NASDAQ: Global electronic marketplace for buying and selling securities, and the benchmark index for U.S. technology stocks.

Nikkei 225: Price weighted index of Japan's top 225 blue chip companies trading on the Tokyo Stock Exchange.

NYSE: New York Stock Exchange – largest equities based exchange in the world.

Open: The price at which a security first trades upon the opening of an exchange on a given trading day, or at the start of a specific time period.

Option: The right, but not the obligation, to buy or sell a specific amount of a given security at a specified price during a specified period of time.

P/E Ratio: Price Earnings ratio, is a valuation ratio defined as the market price per share divided by the annual earnings per share.

Platinum: Precious metal commodity.

Precious Metals: Classification of metals that are considered rare and have a high economic value.

Predictive Correlation: Mutual relationship between two variables, with one variable leading and predictive of the other.

QE1, QE2, QE3 & QE4: Monetary policy in which a central bank purchases government bonds in order to stimulate the economy by lowering interest rates and increasing the money supply.

Random Walk: Theory that stock price changes are independent of each other, such that past price movements cannot be used to predict future price movements.

Recession: Prolonged economic decline characterized by two or more successive quarters of negative GDP growth.

Rentes: Government security of France, or the annual income from a capital investment.

RSI: Relative Strength Indicator – technical oscillator that indicates overbought and oversold levels.

S&P 500: Standard & Poor's 500 stock index – most commonly used benchmark for the overall U.S. stock market.

S&P GSCI: Standard & Poor's Goldman Sachs Commodity Index comprises 24 commodities from all commodity sectors and is the benchmark of overall commodity performance.

SEC: Securities and Exchange Commission – government commission created by the U.S. Congress to regulate the securities markets.

Secondary Emerging Market: According to the FTSE classification, these emerging markets include low, low middle, upper middle and high income GNI countries with reasonable market infrastructures.

Sell Short: In anticipation that a stock price will fall, the process of selling a borrowed security in order to buy it back in the future at a lower price.

Short Position: The sale of a borrowed security with the expectation that it will fall in value.

Silver: Precious metal commodity used in coinage and jewelry – like gold, it derives its value as an inflation hedge and a store of value.

Slippage: Slippage refers to the difference in price between the time an order is placed and when it is actually executed due to the time lag experienced before another trader takes the other side of a buy or sell trade, and effectively fills the order. Positive slippage occurs when the final execution price is better than the requested price, but in most cases, slippage is negative and results in disadvantageous prices. It is therefore built in as a cost per trade.

SMA: Simple Moving Average – see Moving Average.

Stochastic: Also known as a random process, is a collection of random values.

Stock: Type of security that signifies ownership in a company.

Stock Index: Typically a weighted average of selected stocks in order to measure the value of a section of the stock market.

TARP: Troubled Asset Relief Program - $ 700 billion program created in October 2008 by the U.S. Treasury to stabilize the country's financial system in the wake of the 2008 Financial Crisis.

Technical Analysis: Quantitative and qualitative analysis of historical prices in order to extrapolate future price movement.

Transaction Costs: Expenses incurred when buying or selling securities – include brokerage commissions and spreads.

TRB: Trading Range Breakout – a stock price breaking above (below) its previous *n* day trading range is an indication of positive (negative) momentum.

TWSE: Taiwan Stock Exchange.

U.K.: United Kingdom.

UTY: Philadelphia Utility Index.

Variance: Measures the variability or spread from the mean and is therefore an indication of volatility and risk. Calculated as the average of the sum of the squared differences from the mean.

vice versa: Derived from Latin for "in reverse order".

Wall Street: Street in lower Manhattan that is the original home of the New York Stock Exchange.

XAU: Philadelphia Gold and Silver Index – market capitalization index of the leading precious metal mining companies.

XOI: Amex Oil Index – price weighted index of the leading companies involved in the exploration, production, and development of petroleum.