MODIFIED MOVING-AVERAGE CROSSOVER TRADING STRATEGY:

EVIDENCE IN MALAYSIA EQUITY MARKET

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DECLARATION

I declare that the substance of this project has never been submitted for any degree or postgraduate programs and qualifications.

I certify that all the supports and assistance received in preparing this research paper and all the sources abstracted have been acknowledge in this stated research paper.

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Soh Chuen Yean

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LIST OF ABBREVIATIONS

CTA	Commodity Trading Advisors
FBMKLCI	FTSE Bursa Malaysia KLCI
MA	Moving-Average
MA_{short}	Short period moving-average
MA_{long}	Long period moving-average

ABSTRACT

This study examine the profitability of technical analysis using the most renowned trend-following tool, the original moving-average (MA) crossover strategy, to compare with the conventional simple buy-and-hold strategy, using the evidence from Malaysia equity market the FBMKLCI Index from 2000 to 2014. Specifically, this study investigates the performance of the original moving-average strategy and a modified moving-average crossover strategy with additional trading rules such as entry rule, exit rule, holding rule, and stop-loss rule. The results in this study are consistent to past studies that strongly support moving-average crossover trading strategies. The result here suggests that all combinations of short-MA and long-MA periods of the original MA crossover strategy and majority combinations of short-MA and long-MA of the modified MA crossover strategy outperform market benchmark with higher risk-adjusted return. In addition, the 1-period short-MA demonstrates the best return in both original and modified moving-average crossover strategy; better still the modified strategy outperforms the original strategy with lower frequency of trades which could largely reduce transaction costs and with lower return distribution variability.

Keywords: technical analysis, moving-average crossover, trading strategies, stop-loss

ABSTRAK

Kajian ini mengkaji keuntungan teknikal analisis menggunakan strategi ‘moving-average crossover’ (MA) asal berbanding dengan strategi beli-dan-memegang konvensional, dengan menggunakan bukti daripada pasaran ekuiti Malaysia FBMKLCI indeks dari tahun 2000 hingga 2014. Khususnya, kajian ini menkgaji prestasi strategi ‘moving-average’asal dan strategi ‘moving-average’ diubahsuai dengan peraturan tambahan seperti peraturan kemasukan, peraturan keluar, peraturan memegang, dan peraturan had limit kerugian. Keputusan dalam kajian ini adalah selari dengan kajian lepas yang menyokong strategi ‘moving-average’. Di sini hasilnya menunjukkan bahawa semua kombinasi tempoh MA-pendek dan MA-panjang untuk strategi MA crossover asal dan majoriti kombinasi tempoh MA-pendek dan MA-panjang untuk strategi “MA crossover” diubahsuai mempunyai prestasi yang melebihi penanda aras pasaran dengan pulangan terlaras risiko yang lebih tinggi. Di samping itu, 1-tempoh MA-pendek menunjukkan pulangan yang terbaik dalam kedua-dua strategi “MA crossover” asal dan yang diubahsuai. Strategi yang diubahsuai melebihi prestasi strategi asal dengan frekuensi perdagangan yang lebih kurang, ini mampu mengurangkan kos transkasi dan agihan pulangan kebolehubahan yang lebih rendah.

Keywords: teknikal analisis, “moving-average crossover”, strategi berdagang, had-limit kerugian

CHAPTER ONE: INTRODUCTION

1.0 Introduction

Among many other technical trading strategies, the moving-average crossover trading strategy is commonly known as the most popular trend-following strategies and favorite tool among market practitioners, due to its simplicity in smoothing out market noise and able to identify changes in market trend. For many years, financial practitioners have been using moving-average crossover trading rules for market timing whether when to buy or to sell securities and attempt to profit from the financial market in earning above-average benchmark return and even outperform market benchmark.

Previous studies have found that investment and trading based on the strategies of moving-average crossover has been able to generate higher return than the conventional simple buy-and-hold strategy, when transaction cost is excluded. (Brock, Lakonishock, & LeBaron, 1992; Neely, 2002; Wilcox & Crittenden, 2009; Faber, 2007; Zhu & Zhou, 2009).

In this study, the performance of original moving-average crossover trading strategy for securities in Malaysia is examined. Furthermore, the modified moving-average crossover trading strategy, that has several extra trading rules (entry rule, exit rule, stop-loss rule, holding rule) are added into the original MA crossover trading strategy and is tested whether it produce better risk-adjusted return than the original MA crossover trading strategy and the conventional simple buy-and-hold strategy.

1.1 Background of Study

Until the 21st century, the interest of academic literature in studying technical analysis of the financial market has been growing as some of the technical trading rules help investors to reduce massive losses during bear markets that happened in the 2000s, for example during the Dot-Com Bubble in 2001 and the global financial crisis in 2008 (Zakamulin, 2014).

Technical analysis has been applied for over a century by market practitioners, as a market-timing strategy. The first study on technical indicators on stock price time-series appeared in the 1930s explains correlation analysis. Until the 1960s, the development of "random walk" and "efficient market hypothesis (EMH)" framework suggesting that technical analysis at its weak form of efficient market, cannot earn above-average market return (excess return/alpha return) and disprove the value of analyzing historical prices to forecast future price movement in the market, refute trading rules and systems based on past prices. In other words, the use of technical analysis provides little to no value in examining past prices, as prices follows a random walk (there are randomness in prices) and there is no pattern in price movements.

Many studies also have inclined to proof that technical analysis does not outperform the conventional simple buy-and-hold passive strategy when transaction costs are included (Fama & Blume, 1996; Ready, 1997; Bessembinder & Chan, 1998). Also, there are no superior advantages in using market-timing strategies (Sullivan, Timmermann, & White, 1999; Bauer & Dahlquist, 2012).

However, there are several motivations for investors using technical analysis in their investment decision-making. One reason is that prices may not completely and rapidly reflect all available information in the market (i.e., prices may be reacting slowly towards new information). This signifies information inefficiency in the market. In the efficient market theory, information inefficiency can occur when market is other than strong-form (i.e., weak form and semi-strong form) which allows investors to earn excess return (alpha return). Another reason is the belief of technical analysis that market prices are largely determined by the trading activities that is unrelated to a rational analysis approach of underlying fundamental information. Therefore, technical trading strategies attempt to identify price patterns in trading activity on a timely basis that could be exploited for profit opportunities.

The core of technical analysis lays a belief where direction of future security prices can be predicted by using technical indicators derived from past historical prices. Among the most common presupposition is that security prices move in trends. So, the most widely used market-timing strategy is the trend-following strategy, where it attempts to follow the trend and ride on it.

The most popular strategy of trend-following strategy for market-timing is the moving-average crossover strategy. Among various technical indicators, the moving-averages predominantly show predictive power in the stock market where it matches or exceeds of those macroeconomic variables (Neely, Rapach, Tu, & Zhou, 2013). The use of moving-averages as market timing tool in making investment decision whether to buy, hold, or sell, is an active investment strategy that attempts to outperform the simple buy-and-hold passive strategy.

Numerous studies have found evidence that in favor to the MA crossover strategy (Brock et al, 1992; LeBaron, 1999; Lo, Mamaysky, & Wang, 2000; Neely, 2002; Wilcox & Crittenden, 2009; Faber, 2007; Zhu & Zhou, 2009). They have found that using MA crossover strategy does provide profitability and earn above-average market return as compared to the simple buy-and-hold strategy, excluding transaction costs. Furthermore, simple technical trading strategy can generate comparable returns as compared to investing strategy depending on economic and financial fundamentals (Olszweski, 2001).

In this study, I want to examine the trend-following strategies of the Original and Modified (with additional trading rules) MA Crossover Strategy could outperform the simple buy-and hold passive strategy using the evidence from Malaysia equity market. Taking this further, I want to test whether the Modified MA Crossover Strategy with additional trading rules could enhance the trading performance on top of the original strategy.

1.2 Problem Statement

Given that the widespread classical literature of finance on random walk and efficient market invalidate the use of technical analysis in forecasting future price and profitability of above-average market return, on contrary, while numerous recent studies demonstrate that technical analysis and trading rules that provide buy-sell signals generate better risk-adjusted performance than simple-buy-and-hold strategy, with limited portfolio drawdown risk.

However, many top traders, professional fund managers, and Commodity Trading Advisors (CTAs) use technical analysis and technical trading systems (Schwager, 1995; Covel, 2011). Brorsen (1998) studied the persistence in performance level of managed futures and found that managers' skill and their reliance on different trading systems to make investment decisions have a positive effect on trading performance persistence.

Also, as evident in the bear markets that happened in the 2000s (Dot Com bubble and 2008 global financial crisis) that resulted in a massive drawdown in buy-and-hold investors' portfolio when market indices plunged substantially. Therefore, how the MA Crossover trend-following strategy and additional trading rules could limit this downside risk while enhancing upside portfolio return.

As the simple buy-and-hold strategy is a passive investment management strategy, once investors buy into a portfolio of securities, he/she would may not be making adjustment or rebalancing his portfolio regardless of what happens to the market or changes in the portfolio value. In the event when there are profits on the securities, profits are not taken and the position may be held until the profits are diminished; or when there are losses on securities, losses are held too long. Also, for whatever known or unknown reasons that negatively affect the securities' fundamental, the price of securities are highly expected to be trending down (Chen, Goldstein, & Jiang, 2007), and thus result in increasing portfolio losses if losses are not cut. These demonstrate the disadvantages and problems of the simple buy-and-hold strategy.

Nevertheless, there are several problems with the original MA crossover strategy. Firstly, as the method of moving-average is a trend-following in nature, it would only perform

significantly well when there is trend in market prices; however it perform poorly when there is no trend during sideway market where there is increased frequency of less profitable buy-sell signals at a ranged bound price that could incur high transaction cost.

Secondly, users of MA crossover strategy may be unaware, lacking the knowledge of, or may not fully understand the inherent nature of the trend-following strategy, in which they may come across with the one or many of the following situations:

(1) Given that each past studies using different combinations of short-MA and long-MA period in the moving-average crossover strategy, see Table 1.1, which creates a problem that investors are unsure of which combination of MA crossover period to use in order to produce the best possible strategy return with given level of strategy risk;

(2) Investors are inconsistent or occasionally switching back-and-forth in their approach in using the MA crossover trading strategy (e.g., changing the parameter for short-MA and long-MA), which results in the potential of bias in data-snooping. Besides that, past studies test on the effectiveness of MA crossover strategy in generating higher risk-adjusted return, however they have not address the issue of the risk-return profile in each different combinations of shot-MA and long-MA crossover period as not every strategy is 'one size fits all' for every investor.

(3) Investor may diverge from and not following the trading strategy strictly as they should (Gandevani, 2001). These may result in trading performance that is

inconsistent, unreliable, and underperform the original trading strategy that it should be.

Table 1.1
Different moving-averages parameter are used by different researchers.

Moving-averages parameter	**Researcher**
MA (1,50; 1,150; 5,150; 1,200 and 2,200 days)	Brock et al. (1992) Bessembinder and Chan (1998) Coutts and Cheng (2000) Parisi and Vasquez (2000) Gunasekarage and Power (2011)
MA (1,50 and 1,150 days)	Day and Wang (2002)
MA (1,150 days)	Neftci (1991) LeBaron (1999) Neely (2002)
MA (1,5; 5,20; 1,200 days)	Levich and Thomas (1993)
Short-MA 1 – 12 days Long-MA 5 – 200 days	Olson (2004)
Short-MA 1 – 9 days Long-MA 10, 15, 20, 25, 30 days	Szakmary and Mathur (1997)
Short-MA 1, 2, 5 days Long-MA 50, 100, 150, 200 days	Taylor (2000)

Thirdly, the original MA crossover strategy does not incorporate risk-management approach in its existing strategy to manage its strategy downside risk, as it just only has entry and exit rule.

Therefore, I want to investigate whether the use of MA crossover strategy, provide better risk-adjusted performance than the conventional simple buy-and-hold strategy in the Malaysia equity markets. Also, while maintaining the simplicity of the original moving-average crossover strategy, I want to examine whether additional technical trading rules enhance the overall risk-adjusted return in the modified moving-average crossover

strategy as compared to the original MA crossover strategy and the simple buy-and-hold strategy.

Additional rules such as entry rule, exit rule, stop-loss rule, and holding rule. Specific entry rule is added to increase the probability of winning trade while reducing the probability of losing trade. Specific exit rule is added to exit a trade based on different scenarios. Stop-loss rule is added to manage the downside risk when price move adversely. Holding rule is added for minimum holding period after entering the trade to avoid frequent buy-sell signal during low volatile market (sideway market).

1.3 Research Question

In this paper, I investigate the most renowned and widely use trend-following trading rules, the simple moving-average (SMA) crossover, with the combination of several technical trading rules including entry rule, exit rule, stop-loss rule, and holding rule. Particularly, testing on the Malaysia equity markets, I will use the above technical trading rules as a set of trading strategy to examine its performance against the simple buy-and-hold strategy, to answer the following questions:

1) Does the original MA Crossover trading rules provide better risk-adjusted return (outperform) as compared to the simple buy-and-hold strategy?

2) Which combination/variations of the short-MA and long-MA crossover period trading rule provide the highest risk-adjusted return?

3) Does the modified MA crossover strategy by adding additional trading rules (entry rule, stop loss rule, holding rule) add any value in the trading system in enhancing trading performance?

1.4 Research Objectives

The purpose of this research is to investigate the effectiveness of the most popular trend-following strategy, the MA crossover trading rule and strategy. The following are the research objectives of this study:

- To evaluate whether MA crossover strategy outperform and generate better risk-adjusted return than the simple buy-and-hold strategy.
- To investigate whether which variation or combination of short-MA and Long-MA crossover period provide the highest risk-adjusted return performance.
- To examine whether additional trading rules(entry rule, exit rule, stop-loss rule, and holding rule) in the MA crossover trading strategy enhance trading performance as compared to the original MA crossover strategy.

1.5 Scope and Limitations of Study

In this study, I focus on the most basic, most popular and simplest version of original MA crossover strategy and its modified version by placing emphasis on the robustness of the result across time in the Malaysia context. Here I examine the MA crossover trading strategy using 15-years of daily price data of FTSE Bursa Malaysia KLCI (FBMKLCI)

from 2000 to 2014 as an in-sample data to test the performance of the original and modified MA crossover strategy.

As the intent of this research is aimed to examine the performance of the original and modified MA crossover trading strategy, hence transaction and trading costs are ignored. Trading costs include transaction cost (brokerage fee), liquidity cost (bid-ask spread), market impact costs (the moving price on low liquidity securities), as well as slippage costs (difference between the bid and executed price) and the investor's order amount pushes the security market price (up pressure when buying, down pressure when selling). For instance, rules that signal frequent buy-and-sell will definitely incur higher transaction costs as compared to rules that generate less frequent signals, and such transaction costs must be accounted when contrasting their performances.

On top of that, the liquidity of traded securities is assumed to be highly liquid, where the purchase or sales of such securities can be done at the signal day's closing price. Also, I do not study the asset allocation or number of securities the investor or fund manager intends to buy or sell, nor how much volume can be traded at the closing price. As I am examining the return of such trading strategies of the original and modified MA crossover strategy based on price-level as compared to the simple buy-and-hold strategy.

Although there are many other investment strategies in the portfolio management process, such as Long-Only strategy, Long-Short strategy, Long-Short-Cover strategy, and many others, due to the limitations trading in Malaysia equity market where short-selling is not permitted, this study merely examines Long-Only strategy.

Also, there are numerous strategy variations of the MA trading rule which are examined in this study. Other strategy variations such as the slope (steepness) of the long and short period MA, changes in trading volume are observed before trading decision (buy/sell) are made. Hence, undoubtly that many other MA rules can be innovate and design, and some will work. Nevertheless, the potential dangers of data-snooping are highly possibly.

1.6 Significance of Study

Given the several challenges in using moving-average crossover strategy of: (1) having high frequency of buy-sell signals during sideway markets that increases transaction cost, (2) investors are unsure which parameter of short-MA and long-MA to use, (3) absence of risk-management in the strategy in managing downside risk when price move adversely. This research will examine the effectiveness of both the original MA crossover strategy and modified MA crossover strategy, and how additional trading rules could enhance the trading performance of the modified strategy.

In addition, this study also will look into the inherent nature of MA crossover as a trend-following strategy, which would allow investors to further understand the risk-reward profile of moving-average crossover strategy as well as its pros and cons.

On top of that, as there are many different combinations and variations of short-MA and long-MA period that market participants use in making investment decision, this study examines which of the combinations could provide better risk-adjusted return with lower return variation. On top of that, investors are able to adopt appropriate combinations of moving-averages to suit their individual risk profile.

Furthermore, as the modified moving-average crossover strategy is able to significantly reduce the number of trades as compared to the original moving-average crossover strategy. Reducing frequency of trades allows investors to reduce and save up transaction costs while enhancing return in the long-run.

1.7 Organization of Thesis

The following discuss an overview of the organization in this entire study.

Chapter Two reviews past literatures, studies and theories related to random walk, efficient market, technical analysis, as well as trend-following trading strategies and methods of moving-average, and trading rules which are relevant to this study.

In Chapter Three, I will discuss on research method used in this study, the hypotheses, data collection method, trading rules on the original and modified MA crossover, along with trading performance measurement are elaborated.

In Chapter Four, the performance result of the simple buy-and-hold strategy, the original MA crossover strategy as well as the modified MA crossover strategy will be discussed and compared along with the simple buy-and-hold strategy.

Lastly, in Chapter Five, the major findings in this study, the implications and limitations of the study are summarized and concluded. Besides, both opinions and recommendations for further studies will also be suggested.

1.8 Conclusion

Arguments of classical finance theory on random walk signifies that securities prices move randomly and technical analysis is incapable of predicting price movement, while efficient market signifies that in an efficient market the use of technical analysis is of little to no value and unable to generate excess market return. On the contrary, there are numerous other studies found that the use of technical analysis and trading rules are able to generate risk-adjusted excess market return.

To sum up, this study examine the effectiveness of modified moving-average trading system as a better performance technical trading system comparing original moving-average crossover strategy and simple buy-and-hold strategy. In the following chapter, past studies are reviewed to establish a theoretical groundwork for this research study.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

In this chapter, past studies on technical analysis that using a trading system as compared to the conventional buy-and-hold strategy is reviewed.

I also review studies on the subject of the contrary view of technical analysis, the random walk and efficient market theory, which suggest that in efficient market, no strategies can earn above-average market returns.

As a set of technical trading rules, technical trading strategies and systems have been studied extensively to develop and enhance the accuracy in making investment and trading decisions with an attempt in generating above-average market returns. In view of the questions that directly related to the study's objectives, past theoretical study is examined.

2.1 Efficient Market Hypothesis (EMH)

The Random Walk Hypothesis and Efficient Market Hypothesis (EMH) are the backbone that explains randomness and efficiencies in the financial market. EMH presumes that over long period of time, on average, no strategy can beat or generate excess return over a simple buy-and-hold strategy consistently in the broad market averages.

Any relevant information changes would cause adjustment in securities prices. In other words, it assumes that market behavior reflects relevant information impact prices on securities. However, technical analysts debate that prices adjust upon new information. Therefore, analyzing historical data is valuable in identifying recurring patterns in stock behaviors which leads to active investment strategies that outperform average market returns.

The first person, Bachelier (1900), demonstrates that stock prices follow a random walk process. Then later in mid-20th century (the 1950s and the 1960s), this statistical element is found in the work of Alexander (1961), and later Fama (1965) has originated the concept of efficient market. Subsequently, Roberts (1967) develops the concept as EMH and distinguish weak form and strong form test, which later became the classical work in Fama (1970).

Meanwhile, Samuelson (1965) also gives an extensive construction of the EMH: "Given the assumption that all market participants have cost-less access to all relevant information, when perfect competition arises, prices are equivalent to fundamental values, and the market is efficient." It follows that, the prices has reflected all relevant information, and prices move according to a martingale process. As such, no one could expect to generate excess profit from past price chart analysis or statistical analysis. But Fama (1965) has gone a little beyond that, he has addressed the challenges of both fundamental and technical analysis with the element of Random Walk Theory in stock market prices.

As the academics are commonly skeptical towards methods in technical analysis drawing trend-lines, support-and-resistance levels, and chart patterns on stock price charts to anticipate future price movement seems odd to many. The forecast of future prices from historical prices are considered as useless in EMH's perspective even in weak-form as well (Fama, 1970; Jensen 1978).

Also, the semi-strong form of market efficiency suggests that all publicly available information has reflected in the market prices. Many of the finance literature based on the market efficiency assumption, otherwise if market is not efficient, excess return can be earned, an equilibrium that is unsustainable. Therefore, if the market is efficient, then reliance on publicly available information (i.e., historical price and volume data), the usage of TA, cannot forecast future prices.

Black (1986) argues that prices in the financial market are "noisy", which may create market inefficiencies temporarily that would be eliminated by competition among intelligent investors to capture profitable trades. For instance, day-to-day movement in prices are "noisy", thus it is challenging in identifying a trend or patterns that anticipate following day's price movement in any market. According to the random walk hypothesis in EMH, future price movements are completely unpredictable and it is random, which also signifies that trend-following strategies would not generate above market average return. Conversely, if the markets are not completely efficient, then price trends may be present.

Ever since then, many researchers modeling the financial market by setting an assumption that there are two types of investors, informed and uninformed (Grossman &

Stiglitz, 1980; Diamond & Verrecchia, 1981; Admati, 1985; Campbell & Kyle, 1993). Informed investors have better private information that reflects security's true economic value; whereas uninformed investors do not have information whatsoever, they invest for liquidity needs. Here, Grossman and Stiglitz (1980) propose that the market is not always efficient and efficiency is not possible, for that reason if the markets are really efficient, there would have no inventive and motivation for investors to collect information and trade.

Some recent studies discover that there are some particular kinds of uninformed investors can immobilize market prices for some period of time, given the presence of informed investors (Hirshleifer & Luo, 2001; Luo, 2003). Meanwhile, Kogan, Ross, Wang, and Westerfield (2006) study the long-run feasibility of noise traders in competing against informed traders for survival. They find that as noise traders are as expectedly being exploited by informed traders, however in certain circumstances few of them are able to survive.

Even though past classical studies have established that, in weak-form, markets are efficient; some other studies in contrary provide evidence of technical indicators' ability to forecast. Perhaps the most popular studies done on technical trading rules are by Brock et al. (1992), especially the MA rules. Ignoring transaction costs, they have found that there are two technical trading rules generating consistent predictive power for the DJIA, namely, the MA and trading range break. They have concluded that buy signals produced by the technical trading rules generate higher returns consistently with less volatility as compared to sell signals, in addition sell signals return are negative, that is inconsistent with market equilibrium models.

2.2 Technical Analysis

Technical analysis is the use of past prices, volume and other statistical tools to make investment decisions. Technical analysis practitioners believe that data on past price and volume provide important and useful information in forecasting future price direction and movements in the financial market.

In reality, majority of the brokerage firms and investment advisory services publish commentary reports on the market using TA. Also, many asset management and trading firms practice some sort of technical trading strategies. Numerous technical indicators are employed in practice, such as candlestick chart patterns, levels of support and resistance, MA crossover strategies, relative-strength index (RSI), trading volume, and some other technical indicators developed using statistical and quantitative analysis. Practitioners utilize these technical tools in increasing their winning edge in making investment decisions to exploit profitable price patterns that results from repetitive behaviors in investors.

Schwager (1995) discovers that many fund managers and top traders using TA. Also, Covel (2011) quotes examples of successful large hedge funds that extensively use technical analysis without having fundamental knowledge about the market.

Academics have long been skeptical regarding the practicality of TA, despite the popularity and adoption by market practitioners. Several reasons for academics doubt on the usefulness of technical analysis are: (1) early theoretical studies on random walk and efficient market models disregard excess return and profitability in technical trading (Cowles, 1933; Fama & Blume, 1966); (2) there is no theoretical basis on technical

analysis being research; and (3) challenges in demonstrating the true effectiveness on technical trading rules mainly due to bias in data-snooping (Lo & MacKinlay, 1990; Sullivan, Timmermann & White, 1999; Jegadeesh, 2000) where the same data set are frequently being used for model selection and implication. Thus, it is not astonishing that academics have yet to conclude the effectiveness of technical analysis.

Other past studies provide results that are consistent with the market efficiency through empirical testing that future price cannot be predicted by TA. For instance, the benefits of technical analysis A in generating excess return is offset when transaction costs are included (Fama & Blume, 1996; Ready, 1997; Bessembinder & Chan, 1998).

Conversely, later on studies find that stock returns can be forecast by various economic models (Fama & Schwert, 1977; Campbell, 1987). Recent studies provide further proof on predictability of return using modern theoretical models (Cochrane, 2008; Campbell & Thompson, 2008). Hence, the stock return predictability allows the likelihood of profitable trading rules.

Even though with the contrary opinion in EMH, technical analysis is still being studied extensively by many researchers and market practitioners. Here, there are two philosophies that are contradictory with each other, the random walk efficient market theory and technical analysis. If practitioners' practice of technical analysis is based on hard fact, then it seems that the markets are inefficient. Otherwise, if the markets are informationally efficient, then it appears that the financial community is probably exhausting a huge sum of resources on TA.

Hypothetically, incomplete fundamental information is a major factor investor use TA. Brown and Jennings (1989) demonstrate that rational investors are able to make profit by establishing expectations from past prices. Besides that, Blume, Easley and O'Hara (1994) confirm that investors who utilize market statistics have better performance than those who do not. It is in the circumstances of information insufficiencies, forecasting models that investors employ experiencing model uncertainty even though stock returns are fairly foreseeable.

Several researchers examine different technical trading rules and provide consistent result that technical analysis providing information beyond those that have already reflected in market price (Neftci, 1991; Brock et al., 1992; Neely, Weller, & Dittmar, 1997; Lo et al., 2000). For example, Blume et al. (1994) show that if prices do not react instantly to new information, volume may provide information that is not available in the market.

Among many other studies, Brock et al. (1992), LeBaron (1999), and Neely (2002) show that using MA signals provides profitability and significant gain greater than stock indices.

Wilcox and Crittenden (2009) also confirm that profitability on using TA. Besides that MA strategies can also add value in asset allocation (Zhu & Zhou, 2009).

Faber (2007) demonstrates that technical analysis enhances risk-adjusted return across several asset classes, especially the foreign exchange (forex) markets. While Gehrig and Menkhoff (2006) suggest that technical analysis is equally essential as fundamental analysis for forex traders. Most recent evidence discovered by Neely et al. (2010) on the value of technical analysis in predicting market risk-premium.

Technical analysis can be divided into two main categories (Aronson, 2007), namely: objective and subjective.

2.2.1 Subjective Technical Analysis

Subjective technical analysis comprises of patterns and analysis procedures methods that are not clearly well-defined. As a result, the conclusion from a subjective approach is based on the individual interpretations of the analyst. Given the same method applied to the same set of market data, two analysts may attain completely different conclusions. Hence, it is untestable for subjective methods.

Examples of subjective technical analysis such as hand-drawn trend-lines, classical chart pattern analysis (head-and-shoulder, double/triple bottom and top, wedges and triangles, etc.), Elliot Wave Principles, Magic T's, Gann patterns, and some other subjective approach are under this category.

2.2.2 Objective Technical Analysis

In contrast, objective technical analysis is clearly well-defined. When applying objective method in analyzing market data, its predictions and signals are explicit and unambiguous. This allows simulation back-testing on historical market data and determines accurately its performance level. Objective method back-testing is repeatable that allows claims on its effectiveness with statistical evidence.

2.3 Technical Trading Systems

Over a century, the financial practitioners have been using trading rules and systems attempt to outperform market benchmarks. Past researches have investigated whether such rules generate better results as compared to a simple buy-and-hold strategy (Brock et al., 1992; Fama & Blume, 1996; Sweeny, 1998; Kaufman, 2013).Studies on individual investors and professional fund managers indicate the reliance on trading systems when making an investment decision as one of many reasons they perform more consistently. A hypothesis that a trading system is one determining factor in producing higher trading performance can be generated.

A trading system or strategy is a formal set of trading rules and technical market indicators that indicates when should an investor buy (long), sell (short), or stay neutral. In other words, a trading system produces "buy" or "sell" signals for an investor to follow. Any investors or a trader who make trading decision (buy and sell) without mere impulse or intuition is by definition using some form of a trading system.

A trading system and strategy can be either mechanical (objective) or discretionary (subjective) (Elder, 1993; Tharp, 2009; Covel, 2011). Many conventional mechanical trading models are rule-based systems that utilizes "what if" scenarios. Some of these systems have fewer than 10 rules, some has more rules. The simpler ones use different kinds of technical indicators, moving averages, or some other price pattern formations.

The most popular technical trading system is the trend-following strategy, a renowned investment strategy among Commodity Trading Advisors (CTAs), and systematic quantitative investors in general. Moving averages based trend-following system are the

most popular and simplest among market practitioners (Taylor & Allen, 1992; Lui & Mole, 1998). The MA line is the average of a fixed period of latest stock's closing price developed over a period of time. The MA crossover strategy is the crossing of short-term (fast) MA and long-term (slow) MA. The crossover of fast MA over slow MA from below (above) indicates buy (sell) signal. Using 90-years of data from 1894-1984, Brock et al. (1992) have examined that 26 technical rules applied to the DJIA daily closing price significantly outperformed the benchmark. The moving average was one technical rule that was being studied.

In fact, it is us human beings who make decisions, rather than logical trading systems. Even individuals who use artificial intelligence or mechanical trading systems must make conscious decisions throughout the investment process. From inputting selected data, to whether or not choosing to follow the decision generated by the system, these involve decision-making in the choice of system.

2.4 Buy-and-Hold Strategy

A buy-and-hold strategy is one of the passive investment strategies where an investor buys stocks and holds them for a period of long time. There is no active buying and selling of stocks, once a position is held, investors are neither concern with temporary price fluctuations, security performance nor technical indicators.

While it is commonly referred to as a passive strategy, there are several elements of active management, such as an investors must actively select which stock to buy based on

certain criteria, time the purchase of stock, and hold to the end of some investment horizon (Fabozzi & Markowitz, 2002).

The buy-and-hold strategy is often times advertised as the ultimate investment strategy in stock market investing. Relating to the acceptance in the EMH, as all private and publicly known and available information is discounted into the market price, there is no edge in active trading and dynamically managing investments in consistently outperform a simple buy-and-hold investment over time. In the early past studies, it is shown that technical analysis cannot outperform the simple buy-and-hold strategy after transaction costs are accounted (Fama and Blume, 1966).In fact, several studies have found that investment managers are unable to consistently outperform the passive strategies by stock selection (Day & Wang, 2001).

On the other hand, studies have also discovered phenomena and anomalies in the market that are consistent and can be exploited, placing the EMH open to question (Russell & Torbey, 2002). Numerous studies on these anomalies focused on seasonality and momentum, and these arouse the interest and curiosity of technical traders.

2.5 Trend-Following Strategy

The trend-following strategy is the popular investment style among CTAs, managed futures hedge funds, specific macro traders, and systematic quantitative investors for many decades (Ostgaard, 2008). Trend-following can be define as buying (long) when price has been rising and selling (short) when price has been falling, with the foundation that price trends will likely to continue. In other words, go long when the underlying

trend is positive, while short or cash-out when underlying trend is negative. The long and short signals can be generated using a variation of tools, for instance price breakouts and MA crossovers to determine price trend, whether for broad market indices or individual securities.

Several recent studies have found trend-following strategies to be profitable. Faber (2007) finds that using trend-following as a technical allocation strategy in market-timing can generate a portfolio with enhanced return (equity-level of returns) and greatly reduce risk (bond-level of volatility) comparing to the buy-and-hold strategy. As trend-following strategies are commonly based on rules, losers (losses) are cut short mechanically while winners (gains) are left to run. In which this is commonly contrary to investors' natural instincts. Several others examples of trend-following effectiveness are studied in equity markets (Wilcox & Crittenden, 2005) and commodity futures market (Szacmary, Shen, & Sharma, 2010; Hurst, Ooi, & Pedersen, 2010).

While among latest studies, Shynkevich (2012) investigates the similar rules effectiveness in the US equity market, showed that after making adjustments for bias in data snooping, technical trading strategies do not outperform the simple buy-and-hold strategy.

Whereas Friesen, Weller, and Dunham (2009), Ilmanen (2011) and Asness, Frazzini, and Pedersen (2012) discuss widely on the reason why trend-following has succeeded in the past, including herd behavior, disposition and confirmation effects, representative biases, and under-reaction of investor to news.

Sometimes, information disseminates slowly, particularly when information is highly uncertain and/or when assets are illiquid, thus this may lead under-reaction of investor (Hong & Stein, 1997).When investors under-evaluate and under-react new information in making investment decision, the market prices can slowly trend (Barberis, Schleifer, & Vishny, 1998; Zhang, 2003). As such, behavioral biases also can lead to price continuation whether trending up or down (Hong & Stein, 1997; Daniel, Hirshleifer, & Subrahmanyam, 1998).

Momentum is boosted thru the disposition effect when investors are hesitant to cut small losses. In fact, the above phenomena associates with the difference between current price and purchase price, which poor price anchor allows more flexibility in changes in sentiment. And academic evidence suggests that trend-following strategies can generate excess, risk-adjusted returns. Therefore, market-timing strategies have gained popularity in recent years.

As each and every trading strategies has its personal inherent risk that accompanies with its initial entries (Kaufman, 2013). Trend-following strategies are known for its perseverance of entering long (short) position whenever prices go up (down), taking a small cut loss if prices turn down (up), and waiting for the next signal for re-entry. In addition, in trend-following strategies will face high percentage of small losses, while low percentage of large profitable trades.

Contrary to the mean-reversion trading strategies where it must take huge losses in return for a high percentage of smaller profitable trades. However, in this strategy, if the losses

are capped using stop-loss, then there would be a reduction in the percentage of profitable trades.

2.6 Moving-Average (MA)

The rules of trend are extensively used for market timing. Future price direction can be predicted using historical price patterns. The earliest analysis on MA can be originated back in the 1930s (Gartley, 1930). As trend rules are derived from technical indicators calculated from historical prices. Indeed, trend rules based on "fuzzy" support and resistance lines, head-and-shoulder patterns, double-tops/bottoms and some other price chart patterns are considered as subjective technical analysis (as discussed above), are ambiguous, unclear, and difficult to apply or for empirical testing, which result in inconsistent conclusion. Unlike trend rules that are well-defined by statistical testing (for example, time series analysis) using MA, are objective and succinct in its conclusion, and can be constructed via computer algorithm for applying the method to generate buy or sell signals. Also, it can be used as an unbiased estimator for future price prediction.

Undeniably, MA based technical indicator is a trading strategy that is probably the most renowned and widely used methods of trend-following system among financial practitioners (Lui & Mole, 1998; Taylor & Allen, 1992). It has different variation and levels of complexity, which can be presented in a diagrammatic form on price chart. Hence, the MA is easily quantifiable and applies in empirical tests and investment decision-making.

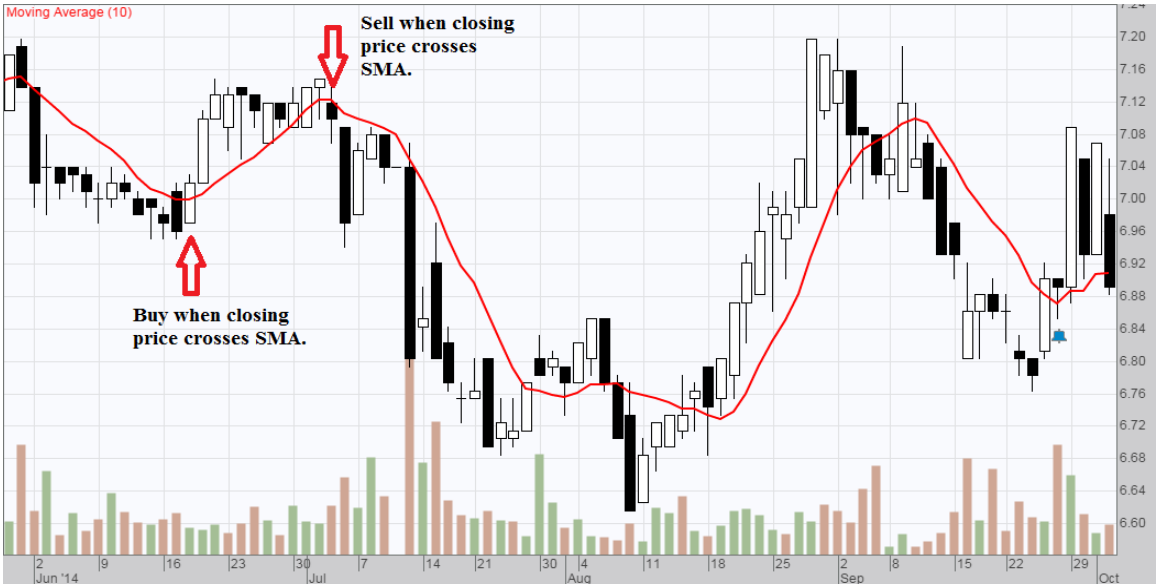

Figure 2.1
10-Period Simple Moving-Average, MA (10).
Source: ChartNexus, 2014.

A moving-average is an average value of recent *n* observations for several sequential period of time (Figure 2.1).

$$MA_t = \frac{P_{t-n+1} + P_{t-n+2} + \cdots + P_t}{n} = \frac{1}{n}\sum_{l=t-n+1}^{t} P_1, n \leq t$$

Where:

MA_t = Moving-average across time t

P = Market price of securities

n = number of period

The moving-average value is the arithmetic average of the most recent *n* data closing price. For instance, using four periods (*n* = 4) to produce a moving-average at the beginning of the data:

$$MA_4 = (p_1 + p_2 + p_3 + p_4)/4$$

$$MA_5 = (p_2 + p_3 + p_4 + p_5)/4$$

$$MA_6 = (p_3 + p_4 + p_5 + p_6)/4$$

Many researchers suggest that a period of 1-day to 9-days as short moving-average; while a period of 10-days and above to be considered as long moving-average (Taylor, 2000; Olson, 2004).

The main purpose of the MA is to smooth out seasonal deviation, reduce the "noise" in the data, and find prices direction. This technical method is to provide a rule for making appropriate investment decision, whether to buy or sell. It compares the short-period moving-average (MA_{short}) to the long-period moving-average (MA_{long}) of the price. When the MA_{short} crosses the MA_{long} from below, which means the MA_{short} is higher (above) by a specific period than the MA_{long}, a buy (long) investment position is taken; conversely, if the MA_{short} crosses the MA_{long} from above, which means the MA_{short} is lower (below) by a specific period than the MA_{long}, a sell (short) position is taken.

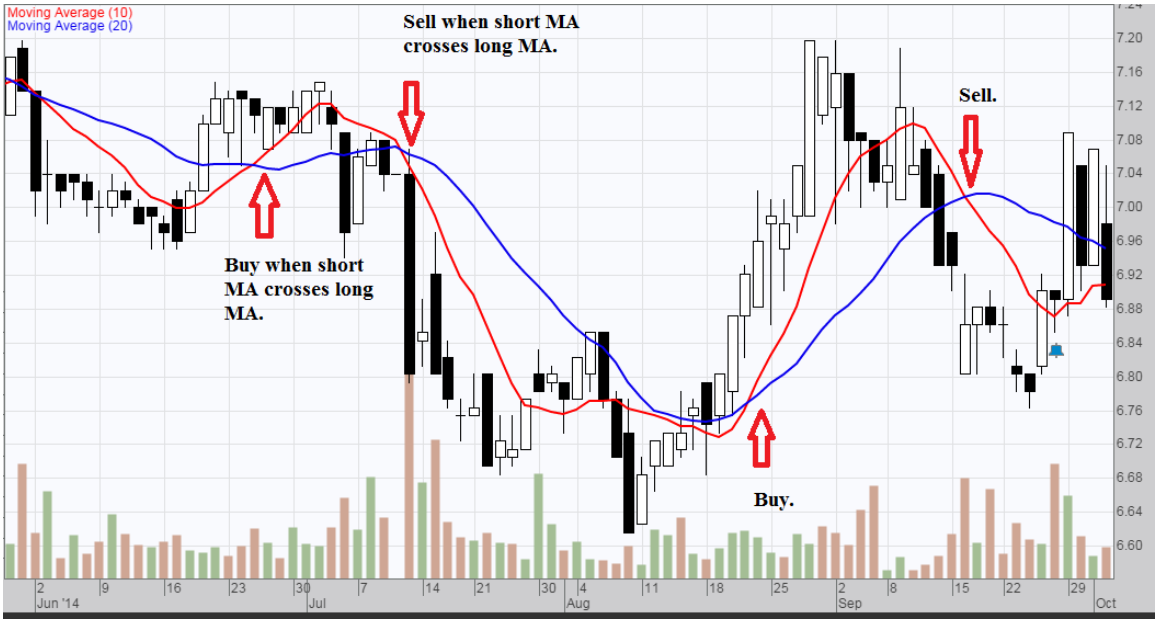

Figure 2.2
Moving-average crossover, MA (10,20).
Source: ChartNexus, 2014.

The portrayal of the MA strategy above is general, and it allows high degree flexibility variation of parameter-value (Figure 2.2).

The MA line can also act as a trend-line. The slow (fast) and long (short) MA period, recognizes the major primary long-run (short-run) trend; whereas the fast and shorter MA period, is used to time entry/exit (Kaufman, 2013). MA identifies the direction of a trend and its strength. Positive slope shows an uptrend, negative slope shows a downtrend. While the slope steepness indicates the trend's strength.

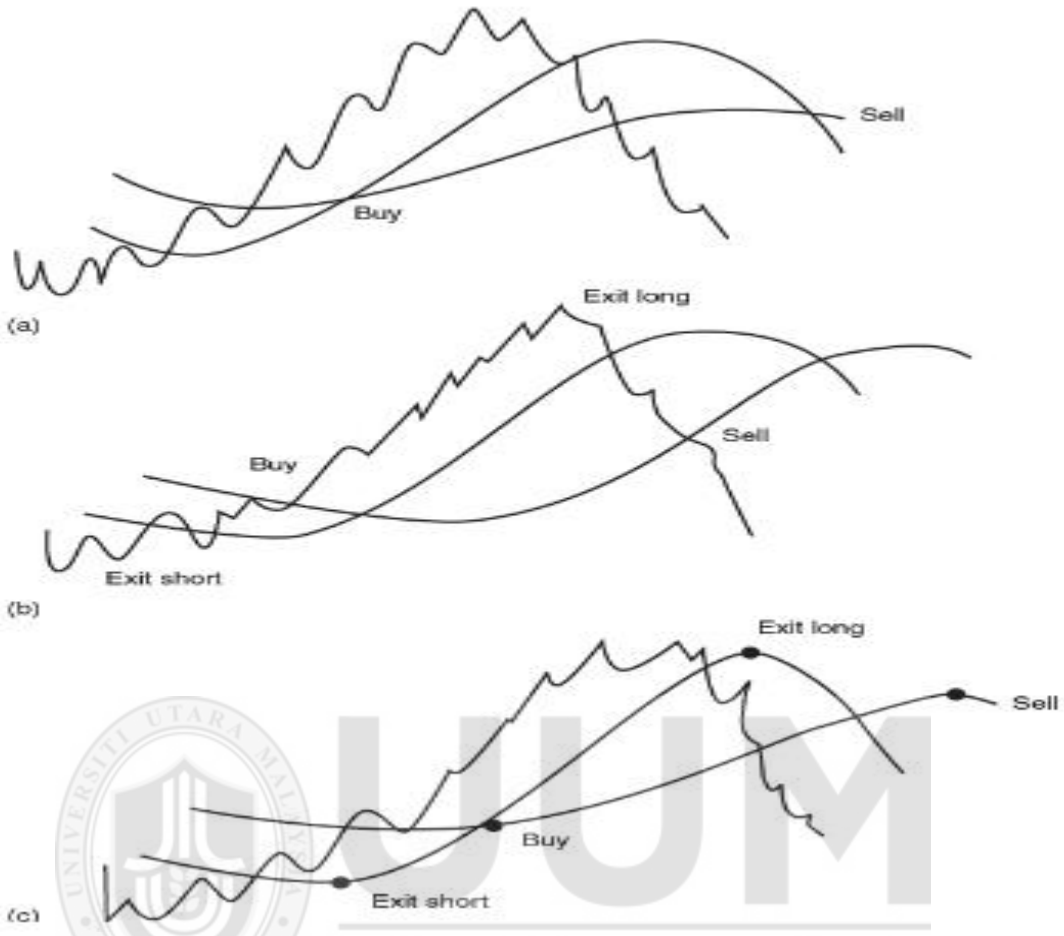

Figure 2.3
3 ways to trade using two MA. (a) Enter and exit when trend-lines cross. (b) Buy and sell when the price crosses the trend-lines, no trade is taken when prices are between the trend-lines. (c) Enter when both trend-lines are moving in the same direction; exit when they show divergence or conflict.
Source: Kaufman (2013), Trading Systems and Methods, 5th Edition, Chapter 8.

Kaufman (2013) suggests that there are 3 ways to trade using dual MA as shown in Figure 2.3 and it is explain below:

1. Buy (Long) when the MA_{short} crosses the MA_{long} going up. Sell (short) when the MA_{short} crosses the MA_{long} going down.

2. Buy when the current price goes above both MAs and exit buy position when price goes below either MAs. Sell short when the current price goes below both MAs, and exit sell positions when price goes above either MAs.
3. Buy when the MA_{short} turns up and the MA_{long} is up. Sell short when the MA_{short} turns down and the MA_{long} is down. Exit trade when the two MAs are moving in opposite directions (divergence).

Trading rule #1 continuously has a trading position in the market, going from Long position to Short position when MA_{short} crosses the MA_{long} from above; and from Short to Long when MA_{short} crosses the MA_{long} from below. Whereas the #2 and #3 set of trading rules form a neutral zone, where no trade position is taken. Trading rule #2 attempts to follow the stronger confirmation part of the price movement based on current market price. Whereas trading rule #3 waits for both MAs trends for confirmation.

MA can be calculated in two (2) ways: simple, and exponential.

- Simple MA (SMA): equal weight is given to all of the observations. Critics: More recent observations should be given greater weight.
- Exponential MA (EMA): More recent observations are given greater weights and emphasis.

Nevertheless, the differences between the two (2) types of MA do not imply the superiority of one type of MA over the other.

When MA_{short} is used, the average line closely follows the market price, and the market price crosses the MA line frequently. In other words, a short (sensitive) MA generates

frequent long and short signals and makes high trading frequency, resulting in a higher transaction cost and many whipsaws (false signals) occur. MA_{short} generates signals earlier for changes in market trend.

A long (less) sensitive MA is more effective when the market upholds in a direction. The long average is less affected by market noises when there is a trend. However, the disadvantage of long average responding slowly towards changes in market direction, and signals will take later time to take effect.

As a result, both of these MA_{short} and MA_{long} cause a dilemma regarding which length of average is appropriate or optimal to be used. Market technicians suggest that moving average is sufficiently sensitive provides beginning stage of new trend, and not too sensitive influenced by market noise. As past studies suggest that 20-day MA demonstrate to be a good base for most applications (Bollinger, 2002). MA_{long} is more efficient when the market direction remains intact, whereas MA_{short} is more efficient for timely changes in direction.

Numerous past studies (Brock et al., 1992; LeBaron, 1999; Gunasekarage & Power, 2001; Maillet & Michel, 2000; Szakmary, Shen, & Sharma, 2010) show that the MA trading rule generated higher return when benchmarked against the simple buy-and-hold strategy. However, when transaction cost is included, the MA trading rule shows insignificant returns (Ready, 2002; Neely, 2003).

Brock et al. (1992) has studied the moving-average crossover system using MA (1,50; 1,150; 5,150; 1,200, and 2,200 days with 0 and 1% bands) and trading range breakout (using 50, 150 and 200 period with 0 and 1% bands) across the sample period of 1897—

1986 on the Dow Jones Industrial Average (DJIA), without adjusting transaction cost. They found that Long (Short) positions across the conditional MA trading rules generated higher (lower) average return consistently than the unconditional MA average returns. Other studies show consistent result when applied the same trading rule on stock index (Coutts & Cheng, 2000; Parisi & Vasquez, 2000; Gunasekarage & Power, 2001; Qi & Wu, 2006) and foreign currency (LeBaron, 1999).

In short, the main purpose of MA is to determine or identify changes in new trend, or to identify the completion of an existing (old) trend. MA is used to "smoothen" market noise and facilitates in determining of a new trend. Also, the MA lags behind current market price. Shorter MA has little lags and it follows the market price closely but sensitive; longer MA is less sensitive and lags behind more than shorter MA. Thus, it would be stimulating to compare shorter and longer MA depending on its predictive power.

2.7 Stop-Loss

A stop-loss rule is one of the money management techniques in managing trading risk. It is usually applied to reduce portfolio's exposure to systematic risks (market risks) when predetermined cumulative loss is reached. It is a contingency rule aimed to establish an exit from an investment when price moves adversely and the loss threshold limit has been reached. Risk management is the top priority for all trading systems. As trend-following strategies has always determined exit protocols to control downside risk to portfolio account (Covel, 2011).

A “stop” also means when to get out of a losing position. Numerous practitioners in the trend following trading system add a stop-loss point together with their entry point to limit their downside risk when the market goes the opposite direction of their trades (see Figure 2.4) (Elder, 1993; Faith, 2007; Tharp, 2009; Covel, 2011). Traders who do not cut or limit their losses will unable to be successful in the long-run.

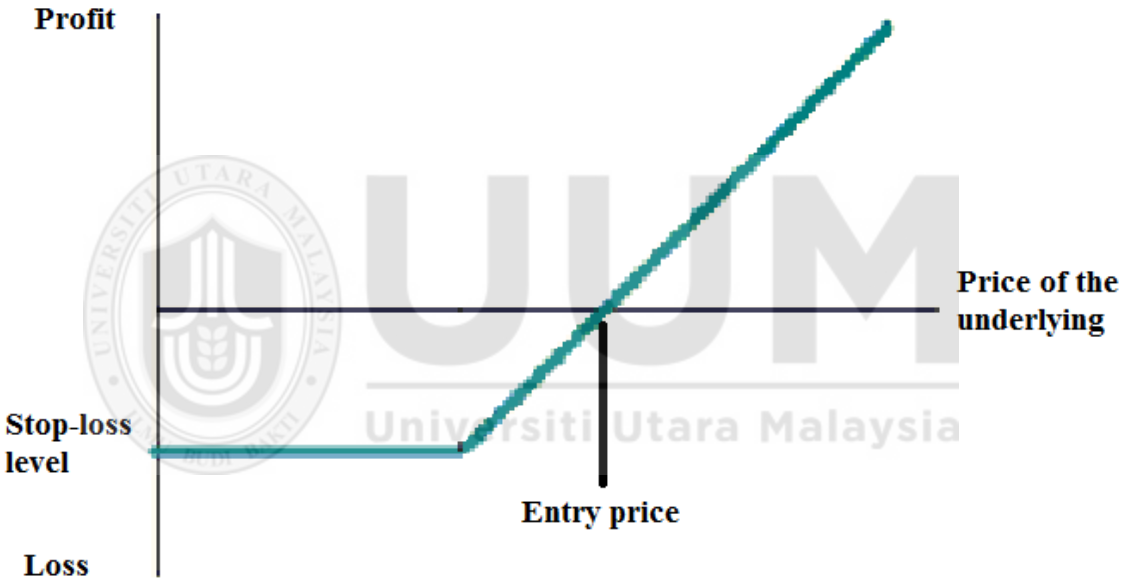

Figure 2.4
Stop-loss rule. When price of underlying is down, downside loss is limited; whereas upside potential is unlimited.

Edward, Magee, and Bassetti (2007) state that there is no absolute and perfect rule for when and where to set the stop-loss level. If the stop level is too close, the position may be closed out too soon with unnecessary losses, and until when the price rebound moving to the initial favorable direction with a profitable rise, in which the initial holding may have resulted in a gain. If the stop-loss level is too far (too wide), trader may take larger

losses than necessary especially in those case where the price definitely has reverse its trend.

Kaufman (2013) states that the feature of stop-loss act as cutting losses quickly, where trend-following strategies get in and out of a trade rapidly, taking a small loss out when loss threshold is hit; but holding the trade position when price is moving in a direction that favors the position taken, trends develop and let profits grow. This kind of strategy is also known as preservation of capital.

Dybvig (1988) and Gollier (1997) also display that the strategy of stop-loss is relatively ineffective compared to other dominating strategies. As such rules can be justified referring to the literatures in behavioral finance in ambiguity and loss aversion, as well as the disposition effect.

Both institutional and retail investors often perceive "stop-loss" as an insurance of portfolio protection. Kaminski and Lo (2008) demonstrate that as the Random Walk theorem and EMH was the prime model during the 1960s and 1970s, few researches on stop-loss procedures are examined. The success and effectiveness of stop-loss rules can be measure by its impact on expected return in portfolio. They display that if the portfolio return follows the random walk, the stop-loss rules will often times decrease the expected return of a trading strategy; if there is momentum in the expected return, such rules will definitely be value-added.

Besides that, stop-loss strategy limits investor losses by cutting short the losing investments. This also benefits investors from holding too long of their losing

investments. These strategies are widely used in practice and are hyped to enhance investment returns.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

This chapter discusses the methodology and experimental design of this study, including the subjects tested, the trading system development, the experimental procedures, the measurement of independent and dependent variables, as well as the description of trading performance analysis.

3.1 Research Framework

This study examines the effectiveness of modified MA crossover trading systems as a better investment strategy than the conventional simple buy-and-hold and the original MA crossover strategy in enhancing investment performance, measured by trading performance analysis, which are the strategy's total net gain, risk-adjusted return (Sharpe ratio), skewness of return, and kurtosis. Particularly, the Modified moving-average crossover trading strategy with additional trading rules such as entry rule, exit rule, holding rule, and stop-loss rule are added onto the Original moving-average crossover trading strategy is studied. In addition, the variation and combination of short-MA and long-MA periods are tested to observe its strategy performance.

Trading strategies is a set of technical trading rules that enhances market-timing accuracy in decision making and improvement in investment return. The strategy performance is the net percentage gained or loss after an investor liquidates all holding position.

3.1.1 Trading System

The investment community has been using trading rules and systems in attempting to outperform market benchmarks for more than a century. Past researches have investigated whether such rules produce better results than the simple buy-and-hold strategy (Brock et al., 1992; Neely, 2002; Olson, 2004; Qi & Wu, 2006; Szakmary, Shen, & Sharma, 2010; Gunasekarage & Power, 2011). Here, I use the moving-average technical indicator generated by a computerize trading system. The following sections describe this experimental system.

3.1.2 Simple Moving Average (SMA)

Computing the averages of recent prices is most likely the most common way for smoothing prices and filtering out "noise" or insignificant market fluctuation and movement. The MA is applied as a technical trading rule in developing the MA crossover trading system applied in this study. According to Kaufman (2013), the MA is the simplest and most renowned smoothing technique of time-series analysis.

Moving average, MA (n) = Sum of *n* closing price / *n*

Where:

n = the number of time periods in moving average

3.1.3 Trading Signals

A trading signal is shown to enter or exit a trade. To enter a trade, a Long Position (Buy order) is executed; when an exit signal is shown, an Exit Long Position (Sell order) is executed to close (liquidate) trading positions.

3.1.3.1 Original Moving-Average Crossover Strategy

The original MA crossover rule is purely based on only entry point and exit point from the MA crossover of short-period MA and long-period MA. There is no stop-loss rule for cutting losses.

Entry Point

Entry point is the open (Buy/Long) position when entry signal is shown at the signal day's closing price. I assume that a Long Position at the signal day's closing price can be taken, rather than the following trading day's opening price.

Here the entry point for the original MA crossover strategy is: Entry signal occurs when MA_{short} crosses MA_{long} from below, and the latest price is above both MA lines, therefore entry trade is made. Trade is only made when the both MA crosses each other and the split of two MA lines, but not the intersection point nor touching of such MAs. Entry price would be on signal day's closing price.

In other words, enter when $Price_{current} > MA_{short} > MA_{long}$.

No entry when $MA_{short} > Price_{current} > MA_{long}$ or $MA_{short} > MA_{long} > Price_{current}$.

Exit Point

Exit point is the close (Sell/Liquidate) position when exit signal is shown at the signal day's closing price. I assume that an Exit Long position at the signal day's closing price can be taken, rather than the following trading day's opening price.

Here, the exit point for the original MA crossover strategy is: Exit signal occurs when MA_{short} crosses MA_{long} from above, and the latest price is below both MA lines, therefore exit trade is made. Trade is only made when the both MA crosses each other and the split of two MA lines, but not the intersection point nor touching of such MAs. Exit price would be on signal day's closing price.

In other words, exit when $Price_{current} < MA_{short} < MA_{long}$.

No exit when $MA_{short} < Price_{current} < MA_{long}$ or $MA_{short} < MA_{long} < Price_{current}$.

3.1.3.2 Modified Moving-Average Crossover Strategy

The modified MA crossover rule is based on the original MA crossover rule (entry rule and exit rule) with some additional trading rules and criteria added with the intention to enhance its trading performance. The additional trading rules and criteria such as stop-loss rule, minimum holding period, no entry on narrow-range day, entry on white candlestick day, etc.

Entry Point

Here, the entry point is based on the original MA crossover strategy. Entry signal occurs when MA_{short} crosses MA_{long} from below, and the latest price is above both of such MA lines, therefore entry trade is made.

In additional to the original MA crossover strategy, the entry-point rule needs to satisfy the conditions described below:

Condition #1: The trading day must be a white candlestick (i.e., Closing price is higher than Opening price). If trading day is a black candlestick even if the original MA crossover rule is satisfied, no trade will be taken, I will wait until next buy signal occurs.

Condition #2: No entry is made if signal day is a narrow-range day or doji (i.e. the real body of candlestick is so narrow that it consist only of a horizontal line, in order words very thin range between the opening and closing price).

In other words, enter when $Price_{current}$ (is a white candle only, not narrow-range day or black candle) > MA_{short}> MA_{long}.

No entry when $Price_{current}$ is a black candle or narrow-range day or MA_{short} > $Price_{current}$ > MA_{long} or MA_{short} > MA_{long} > $Price_{current.}$

Exception: Gaps. A price gap is a blank or empty area on the chart that shows the low price above the prior day's high, or high price below the prior day's low. There are no specific criteria for trading on gaps.

Exit Point

Here, the exit point can be based on either three (3) conditions: (1) the original MA crossover strategy, (2) when price goes below stop-loss level, (3) when price is less than MA_{short} and MA_{long} for more than 10 days upon entry day, but above stop-loss level. When sell signal occurs, exit price would be on signal day's closing price.

Condition #1: For exit based on original MA crossover strategy, exit signal occurs when MA_{short} crosses MA_{long} from above, and the latest price is below both of such MA lines, thus exit trade is taken. In short, exit when $Price_{current} < MA_{short} < MA_{long.}$

No exit when $MA_{short} < Price_{current} < MA_{long}$ or $MA_{short} < MA_{long} < Price_{current.}$

Condition #2: For exit based on stop-loss, exit signal occurs when the current price goes below stop-loss level. Exit will be made on signal day when closing price is below stop-loss level. In other words, exit when $Price_{current}$ < Stop-loss level.

Condition #3: Upon entry, there would be possibilities where sell signal in Condition #1 may occur or if price is less than MA_{short} and/or MA_{long} within or during 10 days after entry day, I will hold it for ten (10) consecutive trading period. Here I denote holding for T + 10.

If within T + 10, price goes below stop-loss level, I will follow Condition #2.

Otherwise, if on T + 11 (the eleventh trading period after entry day), I will follow strategy rule stated in Condition #1 on exiting the trade. In other words, if sell signal still exist on T + 11 (Condition #1: $Price_{current} < MA_{short} < MA_{long}$), I will exit the trade on T + 11 closing price. However, if the price on T + 11 do not fulfill Condition #1, I will hold

the position until the next exit signal is generated following Condition #1 or Condition #2.

Stop-Loss

A stop-loss is a level or an order to Exit (Sell) a security at a specified price with an intention to limit a loss and preserve capital.

Stop-loss level must be determined and set every time an entry trade is made. Here, I will set the stop-loss level at the lowest price of signal day (trade entry day) or lowest price of a trading day prior the signal day, whichever is the lowest.

Table 3.1
Example of stop-loss level based on lowest price of signal day or prior signal day.

	Open	High	Low	Close
Signal Day (T- 1)	1.03	1.05	1.00	1.04
Signal Day (T)	1.04	1.08	1.04	1.06

For example, according to Table 3.1, the signal day low is 1.04, and the previous trading day low was at 1.00, therefore the stop-loss level will be set at the lowest point among the two, which is 1.00.

For exit trade on stop-loss level, exit will be made when the closing price is below the stop-loss level. Exit price will be on closing price of signal day.

3.2 Benchmark

To evaluate the performance of the original and modified MA crossover strategies, I use the performance of a simple buy-and-hold strategy as the market benchmark. Under the simple buy-and-hold strategy, an investor holds the security from the beginning of purchase until the end of his investment holding period. I then compare the investment performance of the original MA crossover strategy and the modified MA crossover strategy with the simple buy-and-hold strategy over the periods of 15 years.

3.3 Hypothesis Development

Brock et al. (1992) have found that all 26 technical trading rules on DJIA (90 years data, 1894—1984) outperformed benchmark significantly. And later studies, LeBaron (1999), Maillet and Michel (2000) and Szakmary, Shen, and Sharma (2010) also show result that is consistent where MA crossover trading rule produce higher return when compared to the simple buy-and-hold strategy.

Faber (2007) applying trend-following strategy for technical allocation in market-timing produced improve return (equity-level of returns) and significantly reduce risk (bond-level of volatility) benchmarking against the simple buy-and-hold strategy.

Wilcox and Crittenden (2005) covering 24,000+ securities across 22 years, showing empirical results that trend-following strategy on stocks offer positive mathematical expectancy in the long-term. Trend-following strategies also show above-average performance in the intermediate horizons in the commodity futures market (Szacmary,

Shen, & Sharma, 2010; Hurst, Ooi, & Pedersen, 2010). Whereas using similar rules in investigating the US equity market, Shynkevich (2012) shows that technical trading strategies cannot outperform the simple buy-and-hold strategy.

Based on the above discussion the following hypotheses are developed.

Hypothesis 1: The original MA crossover trading strategy performs higher or better than the simple buy-and-hold strategy.

Hypothesis 2: The modified MA crossover trading strategy performs higher or better than the simple buy-and-hold strategy.

Hypothesis 3: The modified MA crossover trading strategy performs higher or better than the original MA crossover trading strategy.

3.4 Measurement of Variables

3.4.1 Dependent Variables

The dependent variable is the FBMKLCI return generated employing the various periods of MA crossover trading strategy or the simple buy-and-hold strategy.

FBMKLCI is known for FTSE Bursa Malaysia KLCI, a market-capitalization weighted stock market index that comprises of the 30 largest corporations on the Bursa Malaysia in terms of market capitalization that meet the requirements of FTSE Bursa Malaysia Index

Ground Rules. Prior to 3 July 2009, the index comprises of 100 largest market-cap corporations that made up the KLCI index.

Given the changes in the index component from 100 stocks to 30 stocks, the weightage distribution for the calculation of the index changes as well. Of course the individual stocks that have larger market-capitalization have major influence to the index as compared to those that have smaller market-capitalization.

As the purpose of stock market index is used as a representative to measure the general condition of the stock market, here I would like to highlight that the changes in index component does not affect the strategy of trading on the index using technical analysis as technical analysis is supposed meant to be applicable across multiple asset classes (index, currency, futures, stocks, bonds, and commodities). Moreover, the investment decision-making process for buy, hold, and sell is solely based on technical trading rules applied on the asset class itself, here, the FBMKLCI Index. So the weightage of index component or the index component individual stock price behavior movement does not affect the investment decision rule in this study. Therefore, the data for the FBMKLCI is not necessary for the adjustment into sub-sample period for the transition of changes in index component.

3.4.2 Independent Variables

Variation of Moving-Average Periods

The MA act as the independent variables that provide buy/sell signal which affects portfolio returns. The MA used are 1-day, 10-day, 20-day, 50-day, 100-day, and 200-days.

The combinations of MA crossover strategy would be as the following matrix Table 3.2:

Table 3.2
Combination of MA crossover strategy.

MA_{short}/MA_{long}	1	10	20	50	100	200
1		1,10	1,20	1,50	1,100	1,200
10			10,20	10,50	10,100	10,200
20				20,50	20,100	20,200
50					50,100	50,200
100						100,200
200						

3.5 Data Collection Method

Secondary data on FBMKLCI historical daily prices is collected from the ChartNexus charting software. The calculation of the moving-average is set in the software algorithm.

When the entry signal is generated, entry date, entry price, stop-loss level are recorded. When the exit signal is generated, exit date and exit price are recorded. A round-trip of an entry and an exit of the same position are considered as one trade.

3.5.1 Sampling

The data series used in this study is the daily closing price of FBMKLCI index from first trading day in 2000 (3 January 2000) to the last trading day in 2014 (31 December 2014), a collection of 15-years of daily trading data, inclusive of open, high, low, close price of the FBMKLCI, to back-test the original and modified MA crossover trading strategy.

3.5.2 Transaction Cost

As mentioned in the limitations and literature review, most of the past studies did not use a consistent approach for adjusting transaction costs. For example, Brock et al. (1992) ignore transaction cost in their previous study on MA trading rules. Lo et al. (2000) did not attempt to investigate profitability, but to compare the conditional and unconditional daily returns, and hence transaction cost is not accounted for. Therefore, I analyze the trading rules without accounted for any trading cost, transaction cost or any type of taxes.

All of the experiments in this study are point-only test, as a result performance is examined without considering initial equity, and just the return of a single trade is measured in percentage points. All tests start with zero value and are compounded. All result reports are in percentage points.

3.6 Data Analysis

I use trading performance analysis to analyze my findings on the MA crossover trading strategy.

Table 3.3
Description of trading performance analysis.

Strategy Return	
	Description
MA Period	MA_{short}-MA_{long}.
Total No. of Trades	Number of trades across sample period.
No. of Winning Trades	Winning trades that has positive return, return above 0%.
No. of Losing Trades	Total trades – no. of winning trades. Losing trades that has negative return, return below 0%.
Percentage of Winning Trade	No. of winning trades over total trades.
Percentage of Losing Trade	No. of losing trades over total trades.
Avg. Profit	Total return of winning trades divided by total no. of winning trades.
Avg. Loss	Total return of losing trades divided by total no. of losing trades.
Risk-to-Reward Ratio	Average profit over average loss. How much per unit of return given per unit of risk taken.
Total Strategy Return	Total net return of trading strategy.
Geometric Mean return	The geometric return of strategy return over the number of period or trade. This shows the average compounding return per trade.
Standard Deviation of Return	A measurement used to quantify the amount of dispersion of a set of data values around the mean.
Sharpe Ratio	Measured by the portfolio average return over standard deviation of return. It measures the risk-adjusted return given that how much unit of return earned for every unit of risk taken. Here, I assume risk-free rate is zero.
Min. Loss	Minimum loss for the trading strategy.
Max. Loss	Maximum loss for the trading strategy.
Min. Gain	Minimum gain for the trading strategy.
Max. Gain	Maximum gain for the trading strategy.

Table 3.3 (Continued)

	Description
Skewness	Measurement of probability distribution of a real valued random variable around its mean. Skewness value can be positive (skew to the right) or negative (skew to the left).
Kurtosis	Measurement of tailedness of the probability distribution of a real-valued random variable. Kurtosis of any univariate normal distribution is equals to 3. Platykurtic, kurtosis less than 3. Leptokurtic, kurtosis greater than 3. Also known as excess kurtosis.

CHAPTER FOUR: RESULTS AND FINDINGS

4.0 Introduction

In this chapter, I will discuss the results and findings of the simple buy-and-hold strategy, the original MA crossover strategy, and the modified MA crossover strategy. Here, I will also interpret the results and comparing the results of each strategy and provide some insights on my findings.

4.1 Trading Performance Analysis

4.1.1 Simple Buy-and-Hold Strategy

Table 4.1
Trading performance analysis for the simple buy-and-hold strategy.

Strategy Type	**B&H**
Total No. of Months	180
No. of Positive Months	106
No. of Negative Months	74
% of Positive Months	59%
% of Negative Months	14%
Avg. Profit per month (%)	3.27%
Avg. Loss per month (%)	-3.43%
Min. Loss	-0.05%
Max. Loss	-15.22%
Min. Gain	0.07%
Max. Gain	13.55%
Reward-to Risk Ratio	0.95
Total Strategy Return	111.21%
Geometric Mean Return	4.16%
Standard Deviation of Return	4.41%
Sharpe Ratio	0.09
Skewness	-0.28
Kurtosis	1.17

Table 4.1 shows the trading performance analysis for the simple buy-and-hold strategy across the 15-year period (2000—2014) in the FBMKLCI.

The benchmark return, the simple buy-and-hold strategy generates a total return of 111.21%. Its average monthly return is 0.42% with a standard deviation of 4.41%, therefore the risk-adjusted return (Sharpe ratio) is 0.09 (i.e., for every unit of risk taken, the average monthly return will increase by 0.09%).

The strategy has a maximum drawdown (maximum loss) of -15.22% during October-2008; and a maximum upside gain of 13.55% during April 2009.

The return distribution is quite symmetrical (skewness of -0.28) but with flatter and thinner tail (negative kurtosis of 1.17, platykurtic). This shows that the central mean is lower and broader, and its tails are thinner and shorter. Returns following this distribution have less frequency of extreme fluctuations from the mean which makes the investment using this simple buy-and-hold strategy less risky.

4.1.2 The Original Moving-Average Crossover Strategy

Table 4.2
Trading performance analysis for the MA_{short} 1-period original MA crossover strategy.

Strategy Type	**MA** (1,10)	**MA** (1,20)	**MA** (1,50)	**MA** (1,100)	**MA** (1,200)
Total No. of Trades	224	144	79	44	39
No. of Winning Trades	100	67	27	21	16
No. of Losing Trades	124	77	52	23	23
% of Winning Trades	45%	47%	34%	48%	41%
% of Losing Trades	55%	53%	66%	52%	59%
Avg. Profit per trade (%)	3.22%	3.60%	7.84%	8.45%	9.09%
Avg. Loss per trade (%)	-0.81%	-0.94%	-0.99%	-1.46%	-0.71%
Min. Loss	-0.03%	-0.05%	-0.12%	-0.16%	-0.11%
Max. Loss	-5.66%	-7.39%	-3.72%	-3.55%	-1.91%
Min. Gain	0.02%	0.14%	14%	0.07%	0.02%
Max. Gain	16.42%	20.05%	42.01%	41.14%	30.59%
Reward-to Risk Ratio	3.99	3.84	7.90	5.78	12.74
Total Strategy Return	726.47%	381.79%	312.85%	247.02%	220.19%
Geometric Mean Return	0.95%	1.10%	1.81%	2.87%	3.03%
Standard Deviation of Return	3.05%	3.75%	7.14%	9.94%	8.14%
Sharpe Ratio	0.31	0.29	0.25	0.29	0.37
Skewness	2.24	2.48	3.44	2.85	2.40
Kurtosis	6.00	8.11	14.04	7.87	5.12

All of the 1-period MA_{short} of the original MA crossover strategies have generated higher total return (strategy return) as well as higher risk-adjusted strategy return as seen in the higher sharpe ratio (Table 4.2), compared to the simple buy-and-hold strategy (Sharpe ratio = 0.09), As the 1-period MA_{short} generate higher return among other short period (i.e., 10-period, 20-period, 50 period, and 100-period) in the MA crossover, MA (1,10) being the highest, followed by MA (1,20), (1,50), (1,100), and (1,200).

Besides that, the reward-to-risk ratio is higher than the simple buy-and-hold strategy, which means, in the long-run, following the MA crossover strategy, would have a positive mathematical expectancy of higher average profit per trade against lower average loss per trade, and the net-payoff is positive, on average. This also signifies that

the risk for employing the MA crossover strategy is actually less risky in the long-run, given that transaction cost is not included.

As the increase of MA_{long} from 10-period to 200-period, the frequency of trades has greatly reduced. The two short-period MA crossover (e.g., MA (1,10) shows the most trading frequency as compared to one short period MA with one longer period MA crossover (e.g., MA(1,200)), as the former strategy generates frequent trading signals than the latter. This is because of the smoothing effect of MA, as increase in the number of period for smoothing, the MA line would be flat across time, trading signals reduced. Although the former generates frequent trading signals with small average return per trade and small return volatility, however in the long-run, the strategy generates larger total strategy return than the latter strategy that has less frequent trading signal, with large average return per trade and large return volatility.

The entire MA crossover returns are positively skewed to the right, except for MA (50,200) and (100,200) which is quite symmetrical.

Also, many of the MA crossover periods have excess kurtosis (kurtosis > 3, leptokurtic) where its central mean is taller and sharper with longer and fatter tails. This shows that the return distribution has clustered around the mean, nevertheless the fat tail comes from outlier events indicating extreme value of return observations are highly expected to take place.

Table 4.3

Trading performance analysis for the MA_{short} 10-period original MA crossover strategy.

Strategy Type	**MA** (10,20)	**MA** (10,50)	**MA** (10,100)	**MA** (10,200)
Total No. of Trades	63	29	17	13
No. of Winning Trades	30	17	8	7
No. of Losing Trades	33	12	9	6
% of Winning Trades	48%	59%	47%	54%
% of Losing Trades	52%	41%	53%	46%
Avg. Profit per trade (%)	6.34%	10.38%	19.24%	19.35%
Avg. Loss per trade (%)	-2.10%	-3.35%	-2.08%	-3.19%
Min. Loss	-0.08%	-0.42%	-0.11%	-0.31%
Max. Loss	-7.49%	-6.79%	-7.56%	-9.62%
Min. Gain	0.29%	0.67%	0.99%	1.64%
Max. Gain	32.10%	42.93%	40.43%	48.73%
Reward-to Risk Ratio	3.01	3.10	9.23	6.07
Total Strategy Return	189.28%	222.46%	225.60%	166.44%
Geometric Mean Return	1.70%	4.12%	6.08%	7.83%
Standard Deviation of Return	6.97%	11.91%	12.98%	17.12%
Sharpe Ratio	0.24	0.35	0.47	0.46
Skewness	2.38	2.06	1.65	1.46
Kurtosis	6.94	4.28	2.09	1.56

All of the MA_{short} 10-period original MA crossover also generates higher total strategy return, higher risk-adjusted return and higher reward-to-risk ratio as compared to the simple buy-and-hold strategy (Table 4.3).

All modified MA crossover strategy with MA_{short} 10-period crossover here is positively skewed to the right. MA (10,20) and (10,50) are leptokurtic; while MA (10,100) and (10,200) are platykurtic.

Here, the MA (10,20) has lower return than MA (10,50) and (10,100). This is due to 10-period MA is closer to 20-period MA relative to longer 50-period and 100-period MA, generated frequent unprofitable crossover signals. This phenomena happens as when the smoothing effect of the two close or near periods of MA (e.g., here 10-period and 20-period) would reduce the price gap (distance) of its MA lines.

Table 4.4

Trading performance analysis for the MA_{short} 20-period, 50-period, and 100-period original MA crossover strategy.

Strategy Type	**MA**	**MA**	**MA**	**MA**	**MA**	**MA**
	(20,50)	(20,100)	(20,200)	(50,100)	(50,200)	(100,200)
Total No. of Trades	27	17	13	14	9	9
No. of Winning Trades	17	11	8	9	6	6
No. of Losing Trades	10	6	5	5	3	3
% of Winning Trades	63%	65%	62%	64%	67%	67%
% of Losing Trades	37%	35%	38%	36%	33%	33%
Avg. Profit per trade (%)	10.23%	13.02%	15.24%	16.13%	18.59%	18.88%
Avg. Loss per trade (%)	-0.92%	-4.57%	-3.10%	-7.34%	-4.72%	-4.91%
Min. Loss	-1.60%	-2.19%	-0.06%	-0.30%	-1.66%	-2.23%
Max. Loss	-6.77%	-6.92%	-7.93%	-16.03%	-10.21%	-10.21%
Min. Gain	0.06%	0.22%	0.68%	0.43%	0.80%	2.22%
Max. Gain	39.90%	58.88%	48.94%	60.99%	38.36%	37.33%
Reward-to Risk Ratio	2.61	2.85	4.92	2.20	3.94	3.85
Total Strategy Return	221.65%	161.10%	148.48%	136.04%	130.08%	132.90%
Geometric Mean Return	4.42%	5.81%	7.25%	6.33%	9.70%	9.85%
Standard Deviation of Return	11.68%	16.47%	15.71%	19.42%	17.06%	16.88%
Sharpe Ratio	0.38	0.35	0.46	0.33	0.57	0.58
Skewness	1.73	2.35	1.73	1.74	0.63	0.56
Kurtosis	2.76	6.11	3.03	3.81	-0.97	-1.09

Table 4.4 shows the original MA crossover strategy for the MA_{short} of 20-period, 50-period, and 100-period. All of them have also generated higher total strategy return, higher risk-adjusted return, and higher reward-to-risk ratio than the simple buy-and-hold strategy.

Here, only MA (50,200) and (100,200) are close to symmetrically distributed. While the others are positively skewed to the right. MA (20,100), (20,200), and (50,100) are leptokurtic, whereas MA (20,50), (50,200), and (100,200) are platykuritc.

Here, I want to highlight that when two long-period MA crossovers are used, the total strategy return drop significantly. The total strategy return starts to drop significantly from MA (20,100) onwards. As two longer-period MA crossovers are used, the total strategy return drops further, even though the sharpe ratio is still high. This is due to the

fact that as increase in period (longer period) used for MA smoothing, the variability of price movement and the slope (steepness) of the MA line would decrease (go flat). And therefore, the frequency of trading and signal generated are greatly reduced, so does the opportunity for profit is reduced as well.

4.1.3 The Modified Moving-Average Crossover Strategy (Modified MA with additional rules)

Table 4.5
Trading performance analysis for the MA_{short} 1-period Modified MA crossover strategy.

Strategy Type	**B&H**	**MA** (1,10)	**MA** (1,20)	**MA** (1,50)	**MA** (1,100)	**MA** (1,200)
Total No. of Trades	180	169	114	63	44	28
No. of Winning Trades	106	92	61	28	21	16
No. of Losing Trades	74	77	53	35	23	12
% of Winning Trades	59%	54%	54%	44%	48%	57%
% of Losing Trades	14%	46%	46%	56%	42%	43%
Avg. Profit per trade (%)	3.27%	3.54%	3.88%	7.71%	8.45%	9.24%
Avg. Loss per trade (%)	-3.43%	-1.24%	-1.53%	-1.42%	-1.46%	-1.01%
Min. Loss	-0.05%	-0.31%	-0.02%	-0.12%	-0.16%	-0.11%
Max. Loss	-15.22%	-5.66%	-7.39%	-4.93%	-3.55%	-3.29%
Min. Gain	0.07%	0.03%	0.30%	0.14%	0.07%	0.02%
Max. Gain	13.55%	16.42%	20.05%	42.01%	41.14%	30.59%
Reward-to Risk Ratio	0.95	2.85	2.53	5.41	5.78	9.11
Total Strategy Return	111.21%	791.28%	325.48%	336.36%	247.02%	241.14%
Geometric Mean Return	4.16%	1.30%	1.28%	2.37%	2.87%	4.48%
Standard Deviation of Return	4.41%	3.55%	4.27%	7.97%	9.94%	9.35%
Sharpe Ratio	0.09	0.37	0.30	0.30	0.29	0.48
Skewness	-0.28	1.73	1.95	2.91	2.85	1.81
Kurtosis	1.17	3.57	5.10	10.08	7.84	2.35

Similarly, the modified MA crossover strategy has the similar rule as the original MA crossovers strategy, with additional trading rules of stricter entry rule, holding period rule, exit rule, and stop-loss rule as described in detail in the previous Chapter 3.

All of the modified MA crossover strategies (for MA_{short} 1-period) have generated higher total strategy return, higher risk-adjusted strategy return, and higher reward-to-risk ratio as compared to the simple buy-and-hold. All are positively skewed, and are leptokurtic; except for MA (1,200) is platykurtic.

Likewise, as increasing the number of period in long-period MA smoothing, numbers of trade reduced, trade signals generated are lesser, and total return are lower too. Here, the return for MA (1,10) is the highest and as the long-period MA increases, total return are decreasing as seen in MA (1,200).

Table 4.6

Trading performance analysis for the MA_{short} 10-period Modified MA crossover strategy.

Strategy Type	**MA** (10,20)	**MA** (10,50)	**MA** (10,100)	**MA** (10,200)
Total No. of Trades	59	17	18	15
No. of Winning Trades	28	8	10	6
No. of Losing Trades	31	9	8	9
% of Winning Trades	47%	47%	56%	40%
% of Losing Trades	53%	53%	44%	60%
Avg. Profit per trade (%)	5.90%	17.09%	14.94%	14.06%
Avg. Loss per trade (%)	-1.42%	-1.46%	-1.40%	-2.00%
Min. Loss	-0.19%	-0.52%	-0.22%	-0.59%
Max. Loss	-5.63%	-2.86%	-3.35%	-4.28%
Min. Gain	0.19%	1.92%	0.72%	1.64%
Max. Gain	32.10%	42.93%	40.43%	36.67%
Reward-to Risk Ratio	4.16	11.70	10.65	7.05
Total Strategy Return	134.10%	192.36%	237.28%	78.62%
Geometric Mean Return	1.45%	6.51%	6.99%	3.94%
Standard Deviation of Return	6.11%	13.88%	13.21%	11.01%
Sharpe Ratio	0.24	0.47	0.53	0.36
Skewness	2.79	1.70	1.62	2.08
Kurtosis	10.16	2.02	1.75	4.72

All of the modified MA crossover strategies for MA_{short} 10-period have generated higher total strategy return, higher risk-adjusted strategy return, and higher reward-to-risk ratio, except for MA (10,200) underperformed, as compared to the simple buy-and-hold

strategy (Table 4.6). Here, all are positively skewed, and are leptokurtic; except for MA (1,200) platykurtic.

Given that the MA (1,200) is the lowest performance among all other MA_{short}1-period, because the MA smoothing effect for 200-period reduces trading opportunity and number of trades; in addition with a MA_{short} of 10-period reduces the trading signal further. Therefore, MA (10,200) underperformed.

Table 4.7
Trading performance analysis for the MA_{short} 20-period, 50-period, and 100-period Modified MA crossover strategy.

Strategy Type	**MA**	**MA**	**MA**	**MA**	**MA**	**MA**
	(20,50)	(20,100)	(20,200)	(50,100)	(50,200)	(100,200)
Total No. of Trades	23	13	11	9	9	10
No. of Winning Trades	11	9	5	4	4	6
No. of Losing Trades	12	4	6	5	5	4
% of Winning Trades	48%	69%	45%	44%	44%	60%
% of Losing Trades	52%	31%	55%	56%	56%	40%
Avg. Profit per trade (%)	13.73%	15.41%	18.75%	20.36%	18.73%	16.92%
Avg. Loss per trade (%)	-1.50%	-1.73%	-1.28%	-0.94%	-2.78%	-1.82%
Min. Loss	-0.52%	-0.56%	-0.06%	-0.30%	-0.76%	-0.76%
Max. Loss	-3.69%	-2.99%	-3.78%	-1.57%	-8.35%	-3.01%
Min. Gain	0.58%	1.96%	0.68%	2.99%	0.80%	2.22%
Max. Gain	39.90%	58.88%	48.94%	60.99%	38.36%	37.33%
Reward-to Risk Ratio	9.18	8.89	14.65	21.65	6.74	9.30
Total Strategy Return	220.85%	208.43%	107.04%	86.96%	65.51%	127.32%
Geometric Mean Return	5.20%	9.05%	6.85%	7.20%	5.76%	8.56%
Standard Deviation of Return	12.04%	17.44%	16.44%	20.10%	16.53%	15.06%
Sharpe Ratio	0.43	0.52	0.42	0.36	0.35	0.57
Skewness	1.80	2.21	2.04	2.77	1.49	1.16
Kurtosis	2.49	4.99	3.65	7.92	0.75	-0.26

Table 4.7 shows mixed results for the modified MA crossover strategy. MA (20,50) and (20,100) produce higher total strategy return and higher risk-adjusted return. MA (20,200), (50,100), and (50,200) underperform, while MA (100,200) performance is slightly above than the simple buy-and-hold strategy. The underperformance is due to the stop-loss rule that closed out trades when price went below the stop-loss level. This could

occur due to the following reasons: (1) stop-loss level that is too near the entry price that could not withstand a higher volatility in price movement, thus trades sometimes can be closed out too soon; (2) a whipsaw (price move in the opposite direction rapidly, and recovers back to its original trend).

Here, all MA crossovers are positively skewed to the right. MA (20,50), (50,200), and (100,200) are platykurtic, while MA (20,100), (20,200), (50,100) are leptokurtic.

4.1.4 Comparison between the Original MA Crossover and Modified MA Crossover Strategy

Table 4.8
Comparison of trading performance analysis for the MA_{short} 1-period between the original and modified MA crossover strategy.

Strategy Type		**MA** (1,10)	**MA** (1,20)	**MA** (1,50)	**MA** (1,100)	**MA** (1,200)
Total No. of Trades	Original	224	144	79	44	39
	Modified	169	114	63	44	28
No. of Winning Trades	Original	100	67	27	21	16
	Modified	92	61	28	21	16
No. of Losing Trades	Original	124	77	52	23	23
	Modified	77	53	35	23	12
% of Winning Trades	Original	45%	47%	34%	48%	41%
	Modified	54%	54%	44%	48%	57%
% of Losing Trades	Original	55%	53%	66%	52%	59%
	Modified	46%	46%	56%	42%	43%
Avg. Profit per trade (%)	Original	3.22%	3.60%	7.84%	8.45%	9.09%
	Modified	3.54%	3.88%	7.71%	8.45%	9.24%
Avg. Loss per trade (%)	Original	-0.81%	-0.94%	-0.99%	-1.46%	-0.71%
	Modified	-1.24%	-1.53%	-1.42%	-1.46%	-1.01%
Min. Loss	Original	-0.03%	-0.05%	-0.12%	-0.16%	-0.11%
	Modified	-0.31%	-0.02%	-0.12%	-0.16%	-0.11%
Max. Loss	Original	-5.66%	-7.39%	-3.72%	-3.55%	-1.91%
	Modified	-5.66%	-7.39%	-4.93%	-3.55%	-3.29%
Min. Gain	Original	0.02%	0.14%	14%	0.07%	0.02%
	Modified	0.03%	0.30%	0.14%	0.07%	0.02%
Max. Gain	Original	16.42%	20.05%	42.01%	41.14%	30.59%
	Modified	16.42%	20.05%	42.01%	41.14%	30.59%
Reward-to Risk Ratio	Original	3.99	3.84	7.90	5.78	12.74
	Modified	2.85	2.53	5.41	5.78	9.11
Total Strategy Return	Original	726.47%	381.79%	312.85%	247.02%	220.19%
	Modified	791.28%	325.48%	336.36%	247.02%	241.14%
Geometric Mean Return	Original	0.95%	1.10%	1.81%	2.87%	3.03%
	Modified	1.30%	1.28%	2.37%	2.87%	4.48%
Standard Deviation of Return	Original	3.05%	3.75%	7.14%	9.94%	8.14%
	Modified	3.55%	4.27%	7.97%	9.94%	9.35%
Sharpe Ratio	Original	0.31	0.29	0.25	0.29	0.37
	Modified	0.37	0.30	0.30	0.29	0.48
Skewness	Original	2.24	2.48	3.44	2.85	2.40
	Modified	1.73	1.95	2.91	2.85	1.81
Kurtosis	Original	6.00	8.11	14.04	7.87	5.12
	Modified	3.57	5.10	10.08	7.84	2.35

All of the 1-period MA_{short} of modified MA crossover strategy generates higher strategy return and better risk-adjusted return (except for MA (1,20)) than the original MA

crossover strategy, with lower frequency of trades. Although the kurtosis for the modified MA crossover strategy is also leptokurtic but it is lower than the original strategy. This indicates that the volatility of return is lower than the original strategy, and with higher risk-adjusted return.

Besides that, for the modified MA crossover strategy, the percentage of winning trades increased, whereas the percentage of losing trades decreased.

Table 4.9

Comparison of trading performance analysis for the MA_{short} 10-period between the original and modified MA crossover strategy.

Strategy Type		**MA** (10,20)	**MA** (10,50)	**MA** (10,100)	**MA** (10,200)
Total No. of Trades	Original	63	29	17	13
	Modified	59	17	18	15
No. of Winning Trades	Original	30	17	8	7
	Modified	28	8	10	6
No. of Losing Trades	Original	33	12	9	6
	Modified	31	9	8	9
% of Winning Trades	Original	48%	59%	47%	54%
	Modified	47%	47%	56%	40%
% of Losing Trades	Original	52%	41%	53%	46%
	Modified	53%	53%	44%	60%
Avg. Profit per trade (%)	Original	6.34%	10.38%	19.24%	19.35%
	Modified	5.90%	17.09%	14.94%	14.06%
Avg. Loss per trade (%)	Original	-2.10%	-3.35%	-2.08%	-3.19%
	Modified	-1.42%	-1.46%	-1.40%	-2.00%
Min. Loss	Original	-0.08%	-0.42%	-0.11%	-0.31%
	Modified	-0.19%	-0.52%	-0.22%	-0.59%
Max. Loss	Original	-7.49%	-6.79%	-7.56%	-9.62%
	Modified	-5.63%	-2.86%	-3.35%	-4.28%
Min. Gain	Original	0.29%	0.67%	0.99%	1.64%
	Modified	0.19%	1.92%	0.72%	1.64%
Max. Gain	Original	32.10%	42.93%	40.43%	48.73%
	Modified	32.10%	42.93%	40.43%	36.67%
Reward-to Risk Ratio	Original	3.01	3.10	9.23	6.07
	Modified	4.16	11.70	10.65	7.05
Total Strategy Return	Original	189.28%	222.46%	225.60%	166.44%
	Modified	134.10%	192.36%	237.28%	78.62%
Geometric Mean Return	Original	1.70%	4.12%	6.08%	7.83%
	Modified	1.45%	6.51%	6.99%	3.94%
Standard Deviation of Return	Original	6.97%	11.91%	12.98%	17.12%
	Modified	6.11%	13.88%	13.21%	11.01%
Sharpe Ratio	Original	0.24	0.35	0.47	0.46
	Modified	0.24	0.47	0.53	0.36
Skewness	Original	2.38	2.06	1.65	1.46
	Modified	2.79	1.70	1.62	2.08
Kurtosis	Original	6.94	4.28	2.09	1.56
	Modified	10.16	2.02	1.75	4.72

The MA_{short} of 10-period for modified strategy underperform the original strategy, except for MA (10,100). The minimum loss per trade for modified strategy is lower than the original strategy.

Table 4.10

Comparison of trading performance analysis for the MA_{short} 20-period, 50-period, and 100-period between the original and modified MA crossover strategy.

Strategy Type		**MA** (20,50)	**MA** (20,100)	**MA** (20,200)	**MA** (50,100)	**MA** (50,200)	**MA** (100,200)
Total No. of Trades	Original	27	17	13	14	9	9
	Modified	23	13	11	9	9	10
No. of Winning Trades	Original	17	11	8	9	6	6
	Modified	11	9	5	4	4	6
No. of Losing Trades	Original	10	6	5	5	3	3
	Modified	12	4	6	5	5	4
% of Winning Trades	Original	63%	65%	62%	64%	67%	67%
	Modified	48%	69%	45%	44%	44%	60%
% of Losing Trades	Original	37%	35%	38%	36%	33%	33%
	Modified	52%	31%	55%	56%	56%	40%
Avg. Profit per trade (%)	Original	10.23%	13.02%	15.24%	16.13%	18.59%	18.88%
	Modified	13.73%	15.41%	18.75%	20.36%	18.73%	16.92%
Avg. Loss per trade (%)	Original	-0.92%	-4.57%	-3.10%	-7.34%	-4.72%	-4.91%
	Modified	-1.50%	-1.73%	-1.28%	-0.94%	-2.78%	-1.82%
Min. Loss	Original	-1.60%	-2.19%	-0.06%	-0.30%	-1.66%	-2.23%
	Modified	-0.52%	-0.56%	-0.06%	-0.30%	-0.76%	-0.76%
Max. Loss	Original	-6.77%	-6.92%	-7.93%	-16.03%	-10.21%	-10.21%
	Modified	-3.69%	-2.99%	-3.78%	-1.57%	-8.35%	-3.01%
Min. Gain	Original	0.06%	0.22%	0.68%	0.43%	0.80%	2.22%
	Modified	0.58%	1.96%	0.68%	2.99%	0.80%	2.22%
Max. Gain	Original	39.90%	58.88%	48.94%	60.99%	38.36%	37.33%
	Modified	39.90%	58.88%	48.94%	60.99%	38.36%	37.33%
Reward-to Risk Ratio	Original	2.61	2.85	4.92	2.20	3.94	3.85
	Modified	9.18	8.89	14.65	21.65	6.74	9.30
Total Strategy Return	Original	221.65%	161.10%	148.48%	136.04%	130.08%	132.90%
	Modified	220.85%	208.43%	107.04%	86.96%	65.51%	127.32%
Geometric Mean Return	Original	4.42%	5.81%	7.25%	6.33%	9.70%	9.85%
	Modified	5.20%	9.05%	6.85%	7.20%	5.76%	8.56%
Standard Deviation of Return	Original	11.68%	16.47%	15.71%	19.42%	17.06%	16.88%
	Modified	12.04%	17.44%	16.44%	20.10%	16.53%	15.06%
Sharpe Ratio	Original	0.38	0.35	0.46	0.33	0.57	0.58
	Modified	0.43	0.52	0.42	0.36	0.35	0.57
Skewness	Original	1.73	2.35	1.73	1.74	0.63	0.56
	Modified	1.80	2.21	2.04	2.77	1.49	1.16
Kurtosis	Original	2.76	6.11	3.03	3.81	-0.97	-1.09
	Modified	2.49	4.99	3.65	7.92	0.75	-0.26

The modified MA (20,200), (50,100), (50,200), and (100,200) underperform the original strategy. Only modified MA (20,50) and (20,100) outperform the original strategy.

The outperformance and underperformance due to the stricter additional trading rule that reduces trading signals, and thus lower number of trades. Especially the additional rule

for entry buy signal (entry on white candle crossover, no entry on dark candle or narrow-ranged day), that has significantly filtered out and reduce the signal for buying opportunities when the original strategy shows.

Whereas the 10-day holding rule has reduces number of trades especially during market sideways when sell signal is generated less than 10 trading period. Also, this has increased the return on average per trade, and increase in the return volatility, especially when stop-loss is triggered below original sell signal strategy.

The stop-loss rule has limited the downside loss as the maximum drawdown in the modified strategy is lesser than the original strategy, given the same amount of maximum gain.

4.2 Conclusion

Overall, the technical trading system using MA crossover strategy outperforms the simple buy-and-hold strategy with better risk-adjusted return.

Although some modified MA crossover strategy improve the strategy effectiveness with generate better strategy return, lower distribution of return variability and lesser trade than the original MA crossover strategy, mainly due to the additional trading rule applied to the original strategy; however, some modified MA crossover strategy show lower strategy return and with negative kurtosis.

The original and modified MA crossover using MA_{short}1-period showing the best total strategy performance and best risk-adjusted return among all other combination of MA

crossover. In addition, the modified MA crossover using MA_{short} 1-period show improved risk-adjusted return as compared to the original strategy, with lower excess kurtosis.

Therefore, the modified version of MA crossover strategy where its additional rules of entry rule, holding rule, exit rule, and stop-loss rule only enhance the performance MA_{short}1-period of crossover while showing mixed results for other period of crossover.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.0 Introduction

In this chapter, I will conclude the original and modified MA crossover strategy, its findings, implication of study, the limitation of this study and recommendation for future study.

5.1 Summary of Study

Technical analysis has long been used by market practitioners in attempt to outperform the benchmark or earn excess return as compared to the conventional simple buy-and-hold approach. The trend-following strategies using the tool of MA are the most popular among many types trading strategies in technical analysis.

However, the random walk suggest that there is randomness in price movement while the efficient market theorem weak-form efficiency suggests that available past information on prices and volume cannot be used in predicting future prices and therefore, the use of technical analysis is almost impractical in consistently produce excess returns in the long-run.

Majority of past studies on technical analysis (specifically on MA crossover trend-following strategy) affirms the usefulness and profitability of technical analysis in generating excess return, ignoring transaction costs; while minority of the past studies

show contrary result that technical analysis do not outperform market benchmark when transaction cost is accounted for.

This study investigates whether the original MA crossover strategy and modified MA crossover strategy with additional rules of entry rule, exit rule, holding rule, and stop-loss rule, outperform the conventional simple buy-and-hold strategy in the Malaysia context, using the FBMKLCI index as a sample, across 15-year period of data from 2000 to 2014. On top of that, I also examine whether the additional trading rule, enhances the trading performance of the modified MA crossover strategy.

The result shows that all of the original MA outperforms the simple buy-and-hold strategy with higher strategy return, higher risk-adjusted return, excess kurtosis, and with minimal drawdown. This is consistent with the findings of past studies demonstrating that trend-following strategies are able to outperform market benchmark. Shorter period of MA_{long} used will generate more trading signals as compared to longer period MA_{long}. Trading signals are reduced accordingly, as increased in the period used in the MA_{long}. The 1-period MA_{short} crossover generates the highest return among all other short period MA.

Whereas the modified MA crossover strategy shows mixed results. Majority of the modified strategy do indeed outperform the simple buy-and-hold strategy, only minority that underperforms. When comparing against the original MA crossover strategy, only the MA (1,10), (1,50), (1,200), (10,100), and (20,100) outperform the original strategy with higher strategy return, risk-adjusted return, and lower kurtosis, showing the best strategy. While the rest of the short-period MA underperform the original strategy.

5.2 Implication of Study

In order to achieve better investment return, instead of using the conventional simple buy-and-hold strategy, the original MA crossover can be used to enhance investment return, with lower risk. As the results shown in Chapter 4, where all of the original MA crossover and majority of the modified MA crossover strategy outperform the conventional simple buy-and-hold strategy, over the period of 15 years (2000—2014), as evidenced by higher total strategy return, higher risk-adjusted return (higher sharpe ratio), higher reward-to-risk ratio, and with lower drawdown (maximum loss) on portfolio.

According to the efficient portfolio theorem, all investors are risk-averse and rational, and they aim to maximize economic utility by maximizing return for a given risk. In other words, for the portfolios that have the same level of return, investors should choose the portfolio with lower risk; and, for the portfolios that have the same level of risk, investors should choose the portfolio with higher rate of return. Therefore, to achieve such return objective, measurement of risk-adjusted return can be measured by the Sharpe ratio. Hence, in approaching investment decision investors can adopt the tool of MA crossover strategy, over the long-run, as it can enhance investment performance return, reducing investment volatility, optimizing investment decision making by not taking unnecessary risk for the similar to same return.

Throughout the results being analyzed, I can conclude the trend-following strategy using the MA crossover tool as:

- The percentage (probability) of winning (profitable) trade is lower or equivalent to those of losing trades; the percentage of losing trade is generally

higher than those of winning trades. In other words, there would be high occurrences and even extended sequence of losing trade

- However, the average profit per trade is significantly higher than the average loss per trade, as shown in the return-to-risk ratio. Therefore, given the high probability of losing trades, investors can still be profitable as there are positive mathematical expectancy (positive net-payoff) in the MA crossover strategy.
- Over the long-run, the risk-adjusted return as measured by the Sharpe ratio is higher than the simple buy-and-hold strategy, which means, higher average return (geometric return) with lower standard deviation of return can be achieved.

In Chapter 4, the results show that 1-period MA_{short} crossover for both original strategy and modified strategy generates the highest return among other period of MA_{short}. Whereas the additional rule of entry rule, exit rule, holding rule and stop-loss rule work best when applied to the original MA crossover strategy for MA (1,10), (1,50), (1,200), (10,100), and (20,100). With stop-loss rule, the downside risk for the investment is limited, while the upside return potential is unlimited until exit signal is generated.

As the original MA crossover rule generally perform poorly during the period of ranged market conditions, due to whipsaws occurs that increase the numbers of trading signals that are unprofitable. Here, with the modified MA crossover, the holding rule of minimum 10-day after entry day, coupled with the stop-loss rule, have greatly reduce the whipsaws in ranged market condition, i.e., even when exit signal (other than exit on stop-

loss) occurs within 10-days during entry, position is still held till after 10-days, thus this can be evidenced by the reduced numbers of trades.

As each and every investor has his/her own personal return objectives and risk-tolerance level, being a risk-averse investor, is suggested to employ the combination of short-MA and long-MA crossover strategy that suits his/her personal risk appetite based on the profile of the MA strategy. According to the risk-return tradeoff principle, lower (higher) risk is associated with lower (higher) return. Thus investors that prefer lower (higher) risk assets are expected to have lower (higher) rate of return. Similarly, investors that employ lower (higher) risk strategy are expected to earn lower (higher) rate of return.

Here, using the best performance of 1-period MA_{short} crossover in both original and modified strategy, investors are able adjust the MA_{long} according to their personal risk-appetite:

- Conservative investors whom are risk-averse should employ longer period of MA_{long} as it captures the longer primary trend, fewer trades, and lower drawdown.
- Aggressive investors whom are risk-seeking should employ shorter period of MA_{long} as it has higher frequency of trade on short-term trends, and with higher drawdown.

5.3 Recommendation for Future Study

As per my limitations in this current study, I suggest that future research could incorporate transaction cost in the trading transaction, in order to better investigate the strategy real-return in the real world after taking transaction cost into consideration.

Besides, future studies are encouraged to include out-of-sample data studies such as using other indexes, currency, commodity or individual stocks to reduce the problem of data-snooping bias in order to reflect the trading strategy effectiveness.

5.4 Conclusion

The original MA crossover strategy outperforms the conventional simple buy-and-hold strategy, the outperformance of such strategy shows higher strategy return, higher risk-adjusted return (higher Sharpe ratio) and minimal drawdown.

While the modified MA crossover strategy show mixed result. The additional rule for the modified MA crossover strategy do not show consistent result across all period of MA crossover, i.e., some outperform the original MA crossover strategy while some underperform, and some even underperform the simple buy-and-hold strategy. Among the modified MA crossover strategy that outperform are MA (1,10), (1,50), (1,200), (10,100), and (20,100); these show higher risk-adjusted return and lower kurtosis as compared to the original MA crossover strategy, which signifies higher return with lower return variability.

Contrary to the opinion of efficient market theorem stating that usage of historical prices and volume in technical analysis unable to outperform market benchmark, however, in this study, I have affirm past researches that supports the proposition of employing trend-following strategies in enhancing investment returns.

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