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比較技術指標之 MA、MACD 及 RSI 應用於外匯市場之操作績效

COMPARISON THE TRADING PERFORMANCE OF USING THE TECHNICAL INDEX OF MA, MACD AND RSI IN THE FOREIGN EXCHANGE MARKET

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準碩士推薦函

本校企業管理學系管理科學碩士班研究生 賈格賽漢 君在本系修業 2.5 年，已經完成本系碩士班規定之修業課程及論文研究之訓練。

1、在修業課程方面： 賈格賽漢 君已修滿 36 學分，其中必修科目： 經營專題 、 管理科學 、 研究方法 、 決策專題 等科目，成績及格(請查閱碩士班歷年成績)。

2、在論文研究方面： 賈格賽漢 君在學期間已完成下列論文：

(1)碩士論文：Comparison the trading performance of using the technical index of MA, MACD and RSI in the foreign exchange market

(2)學術期刊：Comparison the trading performance of using the technical index of MA, MACD and RSI in the foreign exchange market

本人認為 賈格賽漢 君已完成南華大學企業管理學系管理科學碩士班之碩士養成教育，符合訓練水準，並具備本校碩士學位考試之申請資格，特向碩士資格審查小組推薦其初稿，名稱：Comparison the trading performance of using the technical index of MA, MACD and RSI in the foreign exchange market，以參加碩士論文口試。

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ABSTRACT

In this study, it compares the trading performances of using the moving average, Moving Average Convergence Divergence (MACD) and Relative Strength index (RSI) in the foreign exchange market. It aims to explore which technical analyses whose performance measured by the correct ratio and cumulative returns are dominant to others. The daily close exchange price of the forex market, which covers the period of Jun-2014 to Dec-2015, is employed to implement the empirical work. The result shows that moving average trading performance is more accurate than other methods.

Keywords: **Foreign Exchange (Forex), Technical Analysis, Moving Average Price Index, MACD**

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CHAPTER ONE

INTRODUCTION

Since 21th century Global financial markets have become increasingly more integrated with the lifting of barriers to the flow of capital across the country. The foreign exchange market is the largest and most liquid markets, estimated at $ 5.3 trillion trading volume every day that makes it become the largest trading market in the financial market.[1] In 1973, the Bretton Woods agreement caused for all countries to have fixed exchange rate and they would set to a certain amount of gold. In 1944, the landmark system for monitory and exchange rate management was established in this agreement. Regarding agreement currencies were pegged to gold. The United States unilaterally terminated convertibility of the US dollar to gold, ultimately bringing the Bretton Woods system to an end and rendering the dollar a fiat currency. It was beginning to develop the foreign exchange market. Supply and demand of the particular currency based on the price of the currency define that foreign exchange markets. Forex market has a lot of benefits compared to other markets: 24-hour operation 5 days a week, an over-the-counter market, and no fixed location. There are two major methods of analysis used to predict the behavior of the Forex Market. Those are Technical analysis and Fundamental analysis. That two analysis totally different, but both can be useful predict tools for the Forex trader. They have the same mission to predict a price action and trend. The technician studies the effect while the fundamentalist studies the cause of market movement.

[1]https://www.quora.com/How-much-volume-is-traded-per-day-in-the-forex-market

Fundamental analysis is including PMI, GDP, Employment change, interest rate, inflation rate, monetary policy…etc. These can be used to determine the trend direction (up or down) of currency prices. Also, the fundamental analysis is used to provide the value of the currency in the long term by applying the macroeconomic variables and a fundamental factor related to the exchange rate. Briefly, that all factors of forex transactions which would provide a basis to determine that country's currency's value is economic indicators of a country and predictions of future economic performance.

On the other hand, technical analysis is used to determine the short-run change in currency. Actually, in the Foreign exchange market widely used method is Technical analysis. Technical analysis or charting that usually includes price and volumes by utilizing historical data created by market reaches at future currency price movements. The technical analysis method predicts future price movement using, such as many types of indicators (MA, MACD, RSI…), trend line, channel, and many types of the pattern (head and shoulder, double top and bottom…).

In this study, it aims to investigate whether the technical indicators can provide the correct information to investors for the price change direction and gives the right signal for investing decision or not. In sum, this research is motivated by the exploring the fact that which technical analysis give a right signal or right direction and return to investor who trade on the foreign exchange market.

In brief, the purpose of the study is demonstrating the trading performances of using the technical tools including the Moving average, MACD and Relative Strength Index (RSI) in forex trading. We try to make a comparison and find out which method's performance is dominant to others on various criteria. Furthermore, this study tries to generate the best trading strategy by applying the technical analysis of the forex market for the purpose of providing the investors and potential investors more valuable information about the forex market.

There are three contributions in this study as following:

1. At first, to provide the evidence to support the technical analysis is useful to be used in the forex market. That is to say, we expect the investor can get the positive abnormal return while using the technical analysis tool.
2. Second, while compare with the more complicate indicators, the performance of the easy model, MA, still is dominant to other methods. And its correct ratio will be better than others.
3. The third, the long days of sample period incorporated into the average price calculation will be better than short days of the sample period for the forex market.

Outline of the Study

Chapter one is about the forex market, the purpose and the contribution of this study.

Chapter two: There are three sections demonstrated the related literature in this chapter. In the first part, it summarizes the relative study of technical analysis. The second part is including the development of the technical analysis. And then, it focuses on the study of using the indicators that Moving average MA), Moving Average Convergence Divergence (MACD) and Relative Strength Index (RSI) which is applied is this study will be discussed in the third part.

Chapter three has the 4 sections. The first section introduced the three kinds of MA (SMA, EMA, and WMA) indicators and the trading rule. Also, the MACD and RSI trading rules were included in the second and third sections. The last section is trading performance. We have used two measurements to investigate the trading performance of using these technical indices.

Chapter four has two sections. The first section showed the statistics for the empirical data and the introduction of the trading performance. The Microsoft excel is used to obtain the cumulative return of simulating trading and the correct ratio of predicting the price change direction to trade the forex exchange using the technical analysis.

The last chapter is about the overall conclusion and the discussion of the study. There are two sections and the trading performances of the three indicators belonged to the first section. Also, the limitation and suggestion for further researchers were included in the second section.

CHAPTER TWO

LITERATURE REVIEW

There are three sections demonstrated the related literature in this chapter: in the first part, it summarizes the relative study of technical analysis. Development of the technical analysis is including second part. And then, it focuses on the study of using the indicators that Moving average MA, Moving Average Convergence Divergence (MACD) and Relative Strength Index (RSI) which is applied is this study will be discussed in the third part.

2.1 Technical Analysis

The technical analysis is an approach that studies past price action for the purpose of forecasting future price movement due to it assume the historical price trend will be repeated in the future. Technical analysis is including many tapes of the pattern and indicator. Numerous of related researches provided evidence to support that technical analysis really helps an investor to do their investing decision. Such as: Lee and Mathur (1996), Neely and Weller (1999), Waheed and Asmah (2013), Hadi, Yazdi and Lashkari (2013), Pinakin (2013). But many studies still provide the opposite conclusion to doubt the information content contained in technical indicators including Fama and Blume (1966), Abbey John (2012), LeBaron (1999) and Neely and Weller (1997). LeBaron (1999) studied the relationship between interventions by the Federal Reserve and returns to a simple moving average trading rule. He found that removing returns on the days prior to U.S. intervention reduced the trading rule excess returns to insignificance. Also Neely and Weller (1997) studied relationship of the Technical Analysis and Central Bank Intervention. They used buying rate of the DEM, GBP, JPY, and CHF. And

they found that no evidence for any currency that contemporaneous information about the occurrence of intervention improves trading rule performance.

The basic concept of technical analyzes theory has been developed based on the assumption of future prices always be predictable from past prices as long as prices reflect changing supply and demand. The information provided by the technical analysis can be used to explore the trend direction. Pring (2002) describe technical analysis as: "The technical approach to investment is essentially a reflection of the idea that prices move in trends that is determined by the changing attitudes to investors towards a variety of economic, monetary, political and psychological forces. The art of technical analysis, for it is an art, is to identify a trend reversal at a relatively early stage and ride on that trend until the weight of the evidence shows or proves that the trend has reversed".

2.2 Development of the Technical Analysis

First technical analysis technique was introduced in Japan in the 17th century, and that is candlestick techniques. The candlestick technically includes many types of the candle pattern such as the doji, the star, the hammer and the hanging man... Since that time, the Charles Dow was introduced own theory which is named "Dow Theory". In the 19th century, the Charles Dow was published that the theory of the 255 "Wall Street" journals. In this journal, Dow surmised a series of theories on how to profitably trade stocks and also highlighted the disposition of the stock markets. He said that "The market is always to be considered as having three movements, all going on at the same time. The first are the narrow movement from day to day. The second is the short swing, running from two weeks to a month or more; the third is the main movement, covering, at least, four years in its duration" Third: Charting (price chart) is the most important development of the technical analysis. It's show of the price action. Price action is a primary tool for countless technical analysis, traders; investor involved all of the financial markets. Fourth Elliot wave, Charles Dow was valuable contributed a great deal to modern technical analysis. One the most well-known innovators are "Elliot Wave Theory". He said that "every market action is followed by reaction, five waves move in the direction of the main trend which is followed by three corrective waves". On the other word, if the trend would be up, there would be 5 waves and the 3 waves of these would be up and the 2 waves of these would be down. Dow and Elliot's theory gave the investors and traders' markets structure a form to work and guidelines which is able to determine how a market movement to move. After that, Gann introduced own theory and he suggested that a technique and a strategy have a time, a period, angels and geometric proportions. These are belonged in market cycles.

2.3 Previous Study

Most of the researchers utilized the technical trading rule to estimate profit based on short run and long run moving average. One of them were Lee and Mathur (1996) and they found that the moving average trading rules are slightly profitable only for the JY/SF and the JY/DM cross-rates, while the trading rules are not profitable for the other four cross-rates (JY/BP, DM/BP, SF/DM, SF/BP). Szakmary and Mathur (1997) found that the MA trading rule is utilized in both futures and the spot foreign currency markets were significantly, also a positive profit could be earned by the four of the five currencies. They also found that the moving average trading rule's return is significantly positive on Fridays and Mondays however the middle of the week MA rules is not significant. The many researchers provided the evidence to support the technical analysis to do the exchange rate trading is profitable. For example, Schulmeister (2008) found that the each of 1024 moving average and momentum model was being produced a positive overall return in the DM/dollar market between 1973 and 1999, but the role of this trading rule started to decline from the 1980s. Neely and Weller (1999) also agreed that the technical analysis tool is useful than other tools.

The momentum trading strategies are used by Neely, Paul, Weller and Ulrich (2007) and applied to the high-frequency data. They found that the significant profit in the emerging markets of the BRICS country as China, Russia, India and South Africa. South Africa's rand was the most profitable constantly whole day and increased substantially from 1 minute to 120-minute trade.

The research paper of Detry (2006) investigated that aims to evaluate the forecasting power of technical rule for the European indexes utilizing daily data to replicate Brock, Lackonishok and LeBaron (1992). They calculated the 10 VMA

(variable length moving averages) rules of Brock, Lackonishok and LeBaron and compared a short moving average of the price with a long moving average. According to his result, the short moving average (3, 4 or 5 days) was above the long moving average (50, 150 or 200 days) plus a certain percentage band, the after day was considered as a buy day. Against it, when the shorter average was below the long average minus the band, the next day was classified as a sell day. Hence they evaluated the following VMA: (1,50,0), (1,150,0), (5,150,0), (1,200,0), (2,200,0), (1,50,0.01), (1,150,0.01), (5,150,0.01), (1,200,0.01), (2,200,0.01) in the 15 European countries. The result showed that this predictive force is the statistically significant for the 11 cases and also this result is robust to risk adjustment for the 10 cases.

The study of Waheed and Asmah (2013) which was named "Analysis of Moving Average Convergence Divergence (MACD) as a Tool of Equity Trading at the Karachi Stock Exchange" was observed the eleven scrips from different sectors on the Karachi Stock Exchange (KSE) and was covered by the period of three years from 2007 to 2009 which is the relevant data for the study. The returns produced by these scrips conversely and "The buy and Hold Strategy" has been compared with the returns of the MACD on the basis of Sharpe Ratio. Their study shown that the MACD is the significantly tool of the equity trade of the Karachi Stock.

Hadi, Yazdi and Lashkari (2013) studied the four currency pairs as EUR-USD, GBP-USD, USD-CHF, and USD-JPY in the paper is named "Technical analysis of Forex of MACD Indicator". In this paper, the MACD got better result in the trading with EUR-USD. The most effective combination of the MACD was the currency regarding generation of the profit has been identified by the EUR-USD. Also, they found that the total loss is produced by the buy signals for all four

traders and the total loss was 1672 pips. Therefore the sell signals were produced 7360 pips' loss which the difference is considerable. Their result showed that the MACD generated more profitable by the buy signals than the selling signals.

Papadamou and Tsopoglou, (2001) used the three methods as the moving average crossover system, the momentum and the MACD on the two currencies (USD-DEM, USD-BR) in the study was named "The Profitability of Technical Analysis Systems on Foreign Exchange Markets". The result shown the MACD system was the most profitable on the USD-BR. The momentum system was more profitable than the moving average crossover system.

Pinakin (2013) compared with the MACD and the Stochastic Oscillator. The purpose of this study was which indicator is more profitable. They used 2 years data of the SBI, HDFC bank and ICICI bank on daily basis. The results showed that the MACD provides a correct signal, a better profit and a higher return than the Stochastic Oscillator. Contrary to it, the signals' periodicity of the Stochastic Oscillator was more than the MACD, however results of these signal not well than the MACD.

The study was named "Revisiting the Performance of MACD and RSI Oscillators in the stock market" of Chong, Ng and Liew (2013) focused the 6 samples which are Milan Committee General, S&P/TSX Composite Index, DAX 30, Dow Jones Industrials and Nikkei 225 Stock Average. They found that the centerline crossover to the RSI has predictive ability in the Canadian and Italian stock markets. In particular, the RSI (21 and 50) rule has more predictive ability than others. The RSI (14, 30/70) rule is also positive about the Dow Jones Industrials Index. The MACD and the RSI rules can generate significant profit for FT30.

CHAPTER THREE

METHODOLOGY

In this chapter, it demonstrates the trading rule suggested by applying the technical analysis and the empirical data. Data consist of 2 years daily closing prices of the EUR-USD, GBP-USD, AUD-USD, USD-JPY, USD-CHF and NZD USD from 02- January 2014 to 31- December 2015 are obtained from Taiwan economic journal/ TEJ/.

3.1 Moving Average

A Moving average indicator is employed to detect the price trend in the future by using the information on the past price. There are 4 types of moving average Simple moving average/ SMA/, cumulative moving average /CMA/, weighted moving average/WMA/ and exponential moving average/ EMA/. And SMA, WMA and EMA are used in this paper. Traders identify trend direction using moving averages. Most of the traders are using the SMA and EMA. A simple average of a security over a defined number of time periods, the exponential moving average (EMA), which gives a bigger weight to more recent prices. And "A weighted moving average (WMA) is an average that is multiplying factors to give different weights to data at different positions in the sample window". As for exponential moving average (EMA) reduce the lag by applying more weight to recent prices. The weighting applied to the most recent price depends on the number of periods in the moving average. In this paper, three types of moving average are used. That says, SMA, EMA and WMA.

According to moving average trading rule buy and sell signals are produced one or two moving averages. Also, MA gives signals by interacting with the price

with different horizons of MA. The most basic type of crossover is when the price of an asset moves from one side of a moving average and closes on the other. Price crossovers are used by traders to identify shifts in momentum and can be used as a basic entry or exit strategy. Most of the simple trading strategy is using two moving averages. Buy or sell signal produced shorter term MA crosses above (below) the longer-term MA (such as, above: MA5>MA50, below: MA5>MA50).

The current price cross below a moving average can signal the beginning of the downtrend. If shorter term moving average crosses below the longer term moving average that crossover called a dead cross (MA5<MA13). Conversely, close above the moving average from below it is beginning of the new trend. This crossover name is Golden cross as shown as Figure 3.1

The following section will demonstrate the definition for SMA, EMA, and WMA. For the Simple Moving average (SMA) it is computed as:

$$\mathrm{SMA} = \frac{\mathrm{Pm} + \mathrm{Pm} - 1 + \cdots + \mathrm{Pm} - (\mathrm{n} - 1)}{\mathrm{n}} \quad (1)$$

Where:

Pm – Price value of the bar

n- Period of averaging

For example: 5 days' simple moving average is the five day sum of closing prices divided by five (11 + 12 + 13 + 14 + 15) / 5 = 13), in which 11, 12, 13, 14, 15 are the trading price for each day in the 5-days sample

In this study, we analyzed 6 compositions of moving average: MA (5 days, 13 days), MA (5 days, 50 days), MA (5 days, 200 days), MA (13 day, 50 days), MA (13 days, 200 days) and MA (50 day, 200 days). Though, SMA, EMA and WMA are calculation different, but trading rule is same.

Rule: A Buy signal is produced shorter term MA crosses above the longer-term MA and sell signal is Produced shorter MA cross below the longer MA.

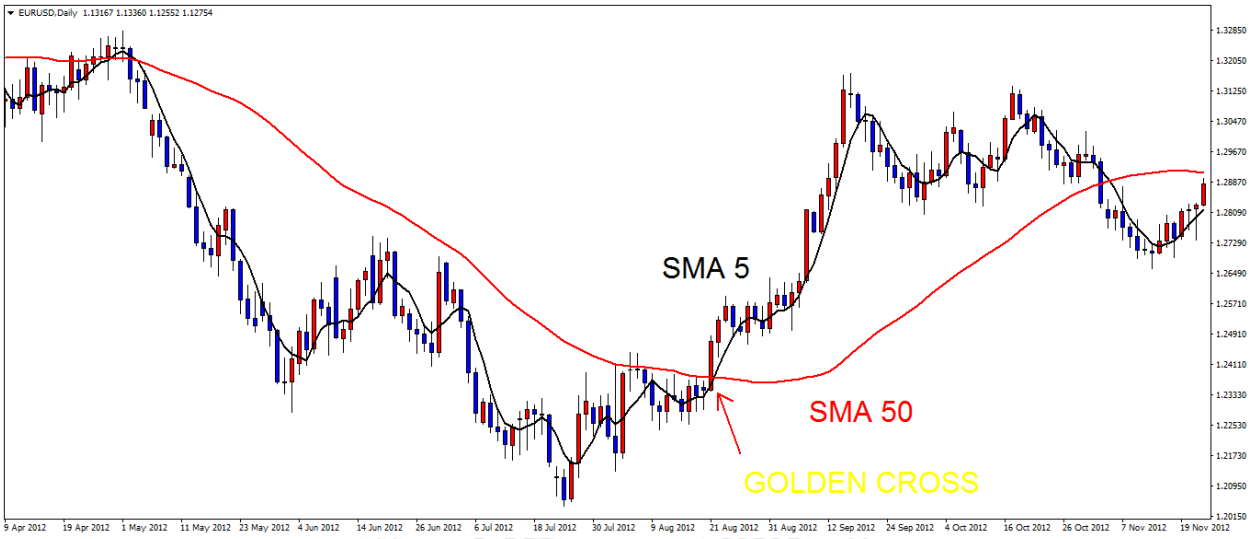

Figure 3.1 The Golden Cross using Simple Moving Averages of Composition SMA (5, 50)

Data source: MT4 EUR-USD daily data

Exponential Moving Average and Calculation

Exponential moving averages decrease the lag by applying more weight to recent prices. The weighting applied to the most recent price depends on the number of periods in the moving average. There are three steps to calculating an EMA.

To calculate an exponential moving average', the Exponent, which is the element in the formula that determines the period of the moving average should be defined first.

$$\text{Exp} = 2/\text{Period} + 1 \qquad (2)$$

For example: the exponent for a 50-EMA is determined by dividing 2 by 51. The result is 0.00995 (2/ (50+1) = 0.039216).

Second, SMA: 10-period sum / 10 for example: For example, if it wants to calculate an EMA for 10 days, the weighting multiplier used in calculating the exponential moving average price is 12+13+14+15+16+17+18+19+10+21/10 = 16.5

Third, calculate the exponential moving average. For the exponential moving average it is computed as:

$$(\text{CDV} \times \text{Exp}) + (\text{PDA} \times (1 - \text{Exp})) = \text{EMA} \qquad (3)$$

Where:

PDA = Prior Day's Average (Begin with simple MA, thereafter PDA is an exponential value.)

Exp = Exponent

CDV = Current Day's Value (CDV is today's forex price)

EMA = Current Day's Exponential Moving Average

For example:

PDA = 52

Exp = 0.039216 (50 -EMA)

CDV = 49

(49 × 0.039216) + (52 × (1 - 0.039216)) = 51.882352

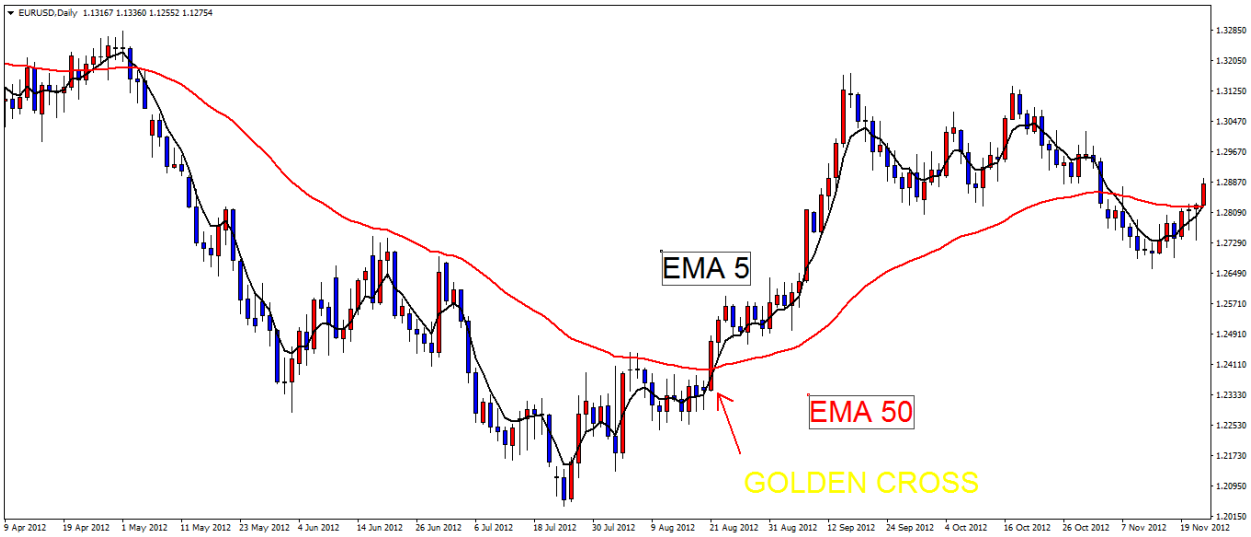

Figure 3.2 Demonstrate the Golden Cross of Using the EMA for Composition EMA (5, 50)

Data source: MT4 EUR USD daily data

Weighted Moving Average (WMA)

A weighted average is an average that is multiplying factors to give different weights to data at different positions in the sample window. Mathematically, the moving average is the convolution of the datum points with a fixed weighting function.[2]

For the Weighted moving average it is computed as:

$$\mathrm{WMA_t}(N) = \frac{\sum_{i=0}^{n-1}(\mathrm{N}-i)\mathrm{P_{t-i}}}{\sum_{i=0}^{N-1}(\mathrm{N}-i)} \quad (4)$$

Where:

MA (N) t is observation

n = the smoothing period

N= Daily Weighted Moving average price

For example: close price 10, 11, 12 WMA 3 and find WMA 12

= (12×3+11×2+10×1)/ (3× (3+1)/2

= (32+22=10)/ (12/12)

=68/6

[2]https://en.wikipedia.org/wiki/Moving_average

=11.33

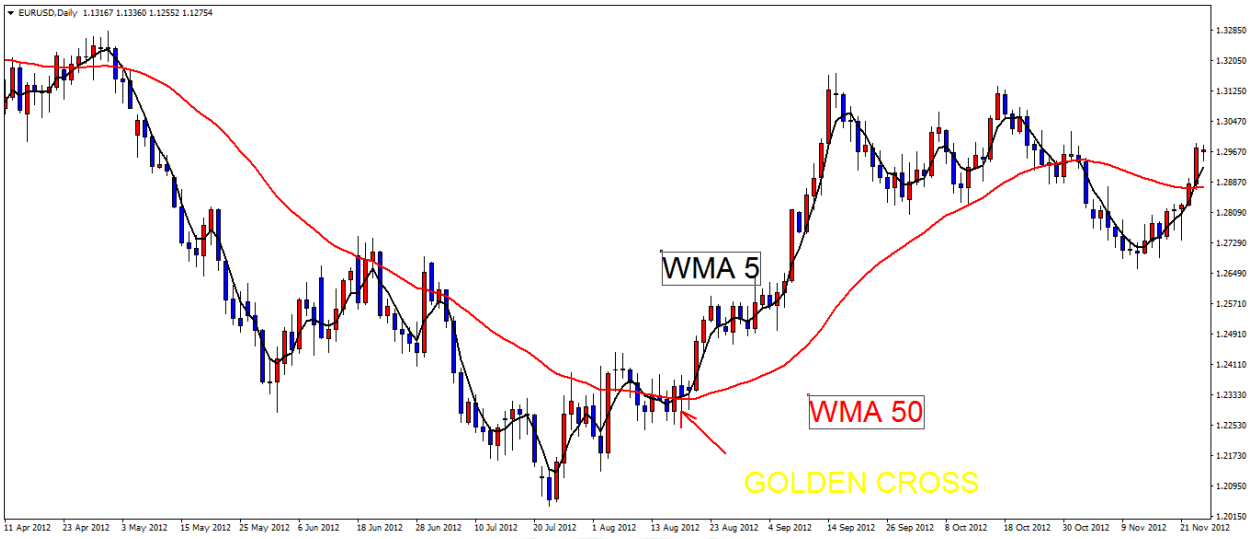

Figure 3.3 The Golden Cross Using
Weighted Moving Average 5, 50

Data source: MT4 EUR-USD daily data

3.2 Moving Average Convergence /Divergence

In 1970, The MACD was by Gerald Appel. The MACD (Moving Average Convergence and Divergence) is in the category of trend indicators that shows the relationship between prices and two moving averages. MACD is one of the most effective momentum indicators available. The MACD turns two trends-following indicators: moving average into a momentum oscillator by subtracting the longer moving average from the shorter moving average. MACD is the most popular indicator that most of the traders use. According the general definition for the factor of calculating the MACD, it is calculated using two EMA 26 days, 12 days and a nine-day EMA of the MACD. MACD divergences are basic elements of the trading signal and traders give a signal that changes the trend direction. There have three movement crossovers, divergence, and zero line. The MACD is constructed by subtracting the long-term moving average from the shorter term moving average. The resulting plot forms a line that oscillates above and below zero, without any upper or lower limits. The MACD is deliberated to be a momentum indicator. Trend followers are widely used MACD. The most popular formula for the MACD is showing the relationship between the 26-day and 12-day exponential moving averages. The signal line is used a nine-day EMA of the MACD. The MACD fluctuates above and below the zero line as the moving averages converge, cross and divergence. Traders can look for signal line crossovers, centerline crossovers and divergences generate signals.

MACD: (12-day EMA - 26-day EMA)
DIP: 9-day EMA of MACD Line
MACD Histogram: MACD Line – Signal

MACD difference, it is computed as:

$$MACD = EMA_{12} - EMA_{26} \quad (5)$$

For the MACD**,** it is computed as:

$$MACD = \left(1 - \frac{2}{1+n}\right) \times MACD_{t-1} + \frac{2}{1+n} \times DIF_{t-1} \quad (6)$$

Where:

n=number of days in moving average

Two different MACD rules are examined:

Rule: A buy signal is generated when the MACD line crosses the zero line and Sell when the MACD line crosses below the zero line. Figure 3.4 demonstrate the cross point of using MACD.

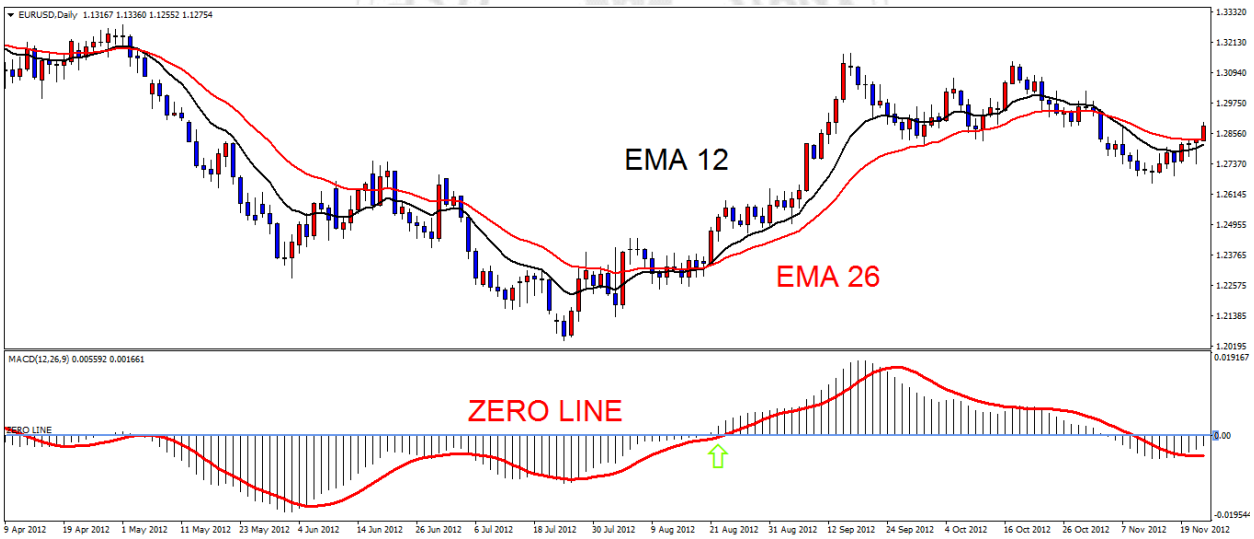

Figure 3.4 MACD Zero line

Data source: MT4 EUR USD daily data

Rule: A buy signal is generated when MACD crosses the nine-day EMA of the MACD from below, while a sell signal is obtained when MACD crosses the nine-day EMA of the MACD from above.

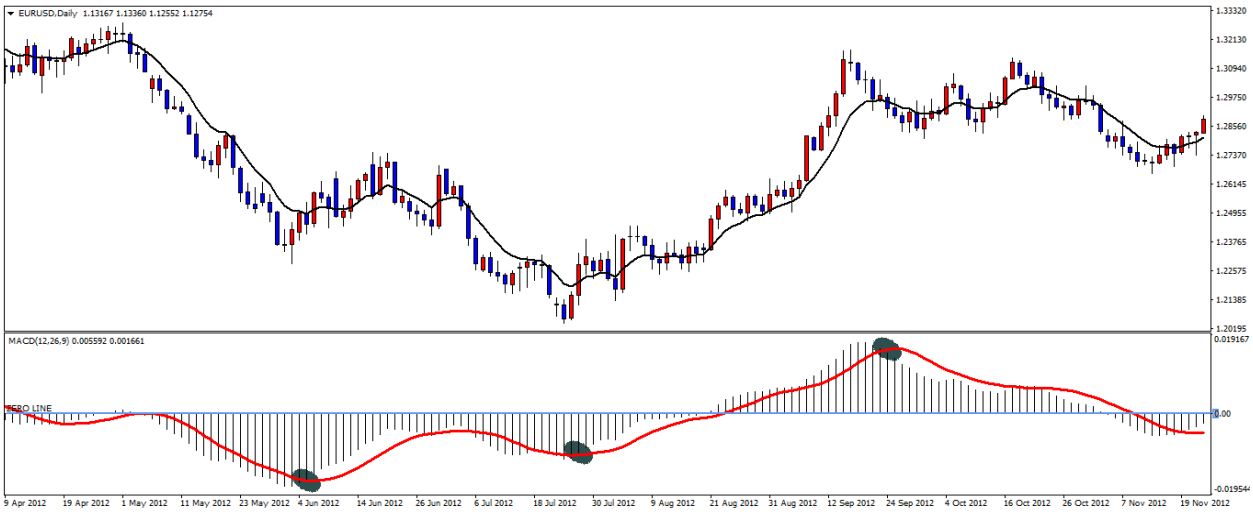

Figure 3.5 MACD

Data source: MT4 EUR-USD daily data

3.3 Relative Strength Index (RSI)

In 1978, The Relative Strength Index (RSI) was developed by J. Welles Wilder; it is a momentum oscillator that shows a measure of the speed and change of the price movement. It is different from MA and MACD. It is a very popular indicator. Wilder suggested that when the RSI moves above 70, the price is getting near a top, or at least a significant reaction conversely the uptrend is near. Against, when the RSI moves below 30, the change of a market bottom or react against the downturn increases. Also, Lane said that "doesn't follow price, it doesn't follow volume or anything like that. It follows the momentum of price and speed. As a rule, the momentum changes direction before the price." Also, he used this oscillator to identify bull and bear set-ups to anticipate a future reversal. Due to the Relative Strength Index is the range bound indicator. It is useful for identifying to overbought and oversold levels. Also, Meyers suggested that in his book "The technical Analysis Course: A winning program for investors and traders" In this book, he said that easy effective way to use this indicators 50 levels. If RSI crossed raises 50 levels, it means buying signal, conversely, RSI crosses down to 50 levels, and it means the selling signal. In this study use RSI level 80 and 20.

For the Relative Strength Index it is computed as:

$$\text{RSI} = \frac{\text{Average of X day}\prime\text{ s closes up}}{\text{Average of X day}\prime\text{s closes Down}} \tag{7}$$

Where:

X = the number of past periods used in the calculation

Closes up = the actual price change on up closes

Closes down = the actual price change on down closes

Rule: A Sell signal is generated when the RSI moves above the 80 level, the market is considered to be overbought and A Buy signal is produced when it moves below the 20 level, the market is considered to be oversold.

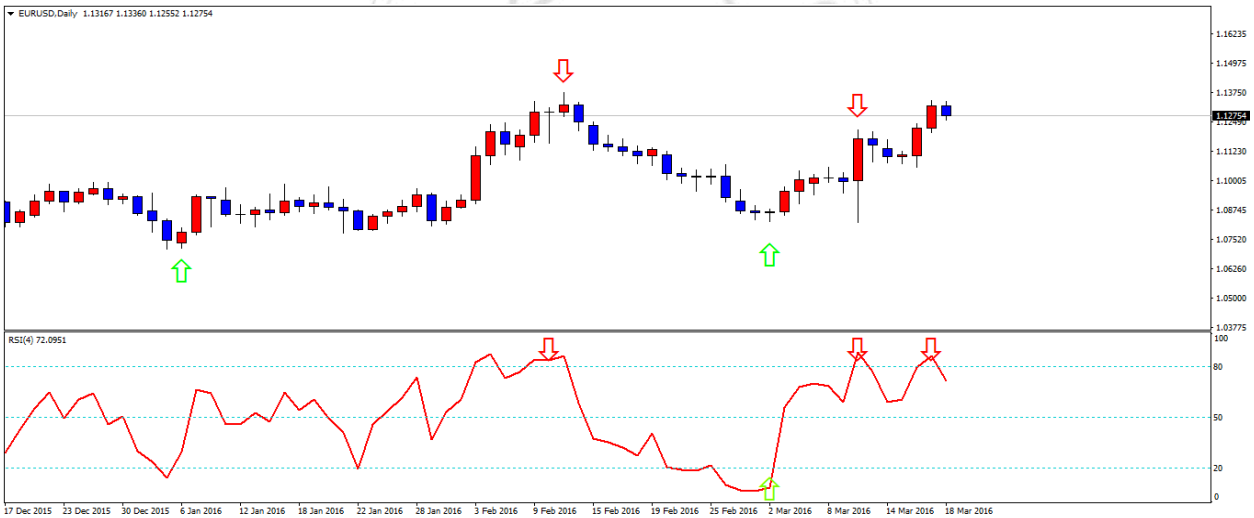

Figure 3.6 EUR-USD, Daily Chart Relative Strength Index

Data source: MT4 EUR-USD daily data

3.4 Trading Performance

This study use 2 measures to investigate the trading performance of using these technical indices. One is the cumulative return, another is the correct ratio for investigate whether the indices can predict the direction of forex price change correctly. As for the cumulative return, it is defined as follow. We calculate the cumulative return (CR) of log and discrete returns. Cumulative return is that, Method of computing total return on an investment in which returns are added on yearly basis. The year-end result shows the reinvestment of dividends, distributed capital gains and change in the value of investment over time. Also, the correct ratio indicates a number of the correct signal which is divided by the total of signal.

For this we used next formula:

If Rt+1>0

$$CR = \sum_{k=1}^{n_1} \mathrm{R}_{\mathrm{t+1}}^{\mathrm{k}} \qquad (8)$$

Where, t - is the time which the signal

$n1$ - number of Rt +1>0 in our empirical data

k - show buying point

Also, we calculated the Directional Accuracy Ratio (DAR) of log and discrete returns.

For this we used next formula:

$$DAR^{(k)} = \mathrm{W}^{\mathrm{k}} \frac{1}{n} \sum_{j=1}^{n} \mathrm{D}_{\mathrm{t+j}} \times 100\%, \ \mathrm{t} = 1,2,\ldots,\mathrm{m} \quad (9)$$

D_{t+j} =1 if t+j buy signal produced Rt+j+1>0, sell signal produced Rt+j+1<0

D_{t+j} =0

$$\mathrm{DAR} = \sum_{k=1}^{n} DAR^{(k)}$$

n is the number of days of trading,

D_{t+j} for the J Daily direction

CHAPTER FOUR

EMPIRICAL RESULT

4.1 The Statistics for the Empirical Data

Table 4.1 showed that the six statistics for daily returns of empirical data of the six pairs in the forex market which is included the mean, the standard deviation, skewness, kurtosis, min, and the max during the empirical period from 1st January 2014 to 31st December 2015. During this period, the lowest average return is NZD-USD (0.76531), after AUD-USD and USD-CHF. For the standard deviation, the highest risk value is USD-JPY (8.7598), followed by EUR-USD (0.11754), AUD-USD (0.82742) and NZD-USD (0.0769), and the lowest risk is USD-CHF (0.0402), the pair of the GBP-USD showed the 0.0402. Also, table 4.1 showed the most of the daily returns are skewed positively of the 3 pairs GBP-USD (0.22734), EUR-USD (0.17495) and USD-CHF (0.06666).and negative of the AUD-USD (-0.00171), USD-JPY (-0.2945) and NZD-USD (-0.2170). All the results of the kurtosis are negatively. The smallest minimum value is NZD-USD (0.62602) and max value is USD-JPY (125.62).

Table 4.1 Statistics for Forex Pairs

	AUD-USD	GBP-USD	EUR-USD	USD-JPY	NZD-USD	USD-CHF
Mean	0.82742	1.58816	1.21936	113.46	0.76531	0.93890
Standard deviation	0.08275	0.07036	0.11754	8.7598	0.0769	0.0402
Skewness	-0.00171	0.22734	0.17495	-0.2945	-0.2170	0.06666
Kurtosis	-1.53137	-1.29724	-1.64751	-1.6903	-1.27418	-0.99457
Min	0.69118	1.43988	1.04965	100.96	0.62602	0.83910
Max	0.94967	1.71644	1.39334	125.62	0.88230	1.03020

Note: Empirical period 2 January 2014- 31 December 2015

4.2 Trading Performance

In this study, Microsoft excel is used to obtain the cumulative return of simulating trading and the correct ratio of predicting the price change direction to trade the forex exchange using the technical analysis during the empirical period 2st January 2014 to 31 December 2015. The cumulative return can be used to measure the trading performance and the correct ratio is the proxy to tell whether the technical index contains the information of price change direction or not. If the correct ratio more than 50%, it means the technical index provides the directional information, otherwise, it is worthless in predicting the price change direction.

Table 4.2 Moving Average 5 and 13

	Pair	SMA 5,13 Correct ratio	WMA5, 13 Correct ratio	EMA 5,13 Correct ratio	SMA 5,13 Cumulative return	WMA 5,13 cumulative return	EMA 5,13 Cumulative return
1	GBPUSD	50%	53%	50%	-4.85%	-2.89%	-2.73%
2	EURUSD	53%	50%	51%	-9.93%	-5.25%	-4.16%
3	AUDUSD	53%	50%	49%	-10.87%	-4.36%	-5.64%
4	NZDUSD	54%	53%	53%	-12.64%	-4%	-3.35%
5	USDCHF	55%	50%	55%	0.00%	-4%	-8.25%
6	USD JPY	44%	40%	46%	-0.10%	4%	4.04%

Note: Empirical period 2 January 2014- 31 December 2015

Table 4.2 compares the trading performances of three kinds of moving average (SMA, WMA, EMA), in which 2 averages price of 5 and 13 days are used to from the trading signals. The table 2 shows the highest correct ratio is 55% for USD-CHF and the lowest correct ratio is 40% for USD-JPY. And the highest cumulative return is 4.04%, which is used EMA (5,130) to trade USD-JPY, the lowest cumulative return is -12.64%, which is used SMA (5, 13) to trade NZD-USD.

Table 4.3 Moving Average 5 and 50

	Pair	SMA 5,50 Correct ratio	WMA 5,50 Correct ratio	EMA 5,50 Correct ratio	SMA 5,50 Cumulative return	WMA 5,50 Cumulative return	EMA 5,50 Cumulative return
1	GBPUSD	51%	52%	52%	-4.89%	-5.22%	-6.25%
2	EURUSD	54%	52%	53%	-9.58%	-10.44%	-9.88%
3	AUDUSD	53%	52%	53%	-0.54%	-9.11%	-11.29%
4	NZDUSD	52%	52%	52%	-10.32%	-9.01%	-12.44%
5	USDCHF	53%	52%	54%	-0.54%	-9.11%	-16.49%
6	USD JPY	42%	45%	41%	2.76%	6.25%	-1.02%

Note: Empirical period 2 January 2014- 31 December 2015

Table 4.3 compares the trading performances of three kinds of moving average (SMA, WMA, and EMA), in which 2 averages price of 5 and 50 days are used to from the trading signals. The table 3 shows the highest correct ratio is 54% for the EUR-USD (SMA) and USD-CHF (EMA), then the lowest correct ratio is 41% for USD-JPY (WMA). And the highest cumulative return is 6.05%, which is used EMA (5, 50) to trade USD-JPY, the lowest cumulative return is -12.44%, which is used EMA (5, 50) to trade NZD-USD.

Table 4.4 Moving Average 5 and 200

	Pair	SMA 5,200 Correct ratio	WMA 5,200 Correct ratio	EMA 5,200 Correct ratio	SMA 5,200 Cumulative return	WMA 5,200 Cumulative return	EMA 5,200 Cumulative return
1	GBPUSD	52%	54%	53%	-1.90%	-3.03%	-1.57%
2	EURUSD	52%	51%	50%	-4.31%	-3.69%	-2.87%
3	AUDUSD	55%	55%	55%	-8.10%	-8.35%	-8.39%
4	NZDUSD	50%	50%	50%	-6.06%	-6.50%	-5.88%
5	USDCHF	55%	55%	55%	-8.10%	-8.35%	-8.39%
6	USD JPY	43%	42%	40%	1.22%	-0.74%	1.11%

Note: Empirical period 2 January 2014- 31 December 2015

Table 4.4 compares the trading performances of three kinds of moving average (SMA, WMA, and EMA), in which 2 averages price of 5 and 200 days are used to from the trading signals. The table 4 shows the highest correct ratio is 55% for USD-CHF and AUD-USD, then the lowest correct ratio is 40% for USD-JPY. And the highest cumulative return is 1.22 %, which is used SMA (5,200) to trade USD-JPY, the lowest cumulative return is -8.39 %, which is used EMA (5, 200) to trade USD-CHF and AUD-USD.

Table 4.5 Moving Average 13 and 200

	Pair	SMA 13,200 Correct ratio	WMA 13,200 Correct ratio	EMA 13,200 Correct ratio	SMA 13,200 Cumulative return	WMA 13,200 Cumulative return	EMA 13,200 Cumulative return
1	GBPUSD	50%	53%	53%	-1.15%	-1.50%	-2.55%
2	EURUSD	53%	50%	56%	-5.62%	-3.69%	-1.8%
3	AUDUD	55%	55%	55%	-8.10%	-8.39%	-8.39%
4	NZDUSD	50%	50%	50%	-6.06%	-6.24%	-6.35%
5	USDCHF	55%	55%	60%	-8.10%	-8.39%	-4%
6	USD JPY	39%	40%	45%	0.46%	1.55%	7.18%

Note: Empirical period 2 January 2014- 31 December 2015

Table 4.5 compares the trading performances of three kinds of moving average (SMA, WMA, and EMA), in which 2 averages price of 13 and 200 days are used to from the trading signals. A table 5 show the highest correct ratio is 60% for USD-CHF and a lowest correct ratio is 39% for USD-JPY. And the highest cumulative return is 7.18 %, which is used EMA (13,200) to trade USD-JPY, the lowest cumulative return is -8.39%, which is used WMA (13, 200) to trade USD-CHF and AUD-USD.

Table 4.6 Moving Average 50 and 200

	Pair	SMA50, 200 Correct ratio	WMA50,200 Correct ratio	EMA 50,200 Correct ratio	SMA 50,200 Cumulative return	WMA 50,200 Cumulative return	EMA 50,200 Cumulative return
1	GBPUSD	52%	55%	53%	-2.91%	-1.72%	-0.84%
2	EURUSD	51%	49%	50%	-4.28%	-1.53%	-4.04%
3	AUDUSD	55%	60%	55%	-8.10%	-3.12%	0.00%
4	NZDUSD	50%	49%	50%	-6.06%	-1.65%	0.00%
5	USDCHF	55%	60%	55%	-8.10%	-3.12%	0.00%
6	USDJPY	36%	46%	45%	0.92%	4.73%	-2.15%

Note: Empirical period 2 January 2014- 31 December 2015

Table 4.6 compares the trading performances of three kinds of moving average (SMA, WMA, and EMA), in which 2 averages price of 50 and 200 days are used to from the trading signals. The table 6 shows the highest correct ratio is 60% for USD-CHF and AUD-USD, a lowest correct ratio is 36% for USD-JPY. And the highest cumulative return is 4.73%, which is used WMA (50,200) to trade USD-JPY, the lowest cumulative return is -8.10%, which is used SMA (50, 200) to trade USD-CHF and AUD-USD.

Table 4.7 Moving Average Convergence Divergence (MACD)

	Pair	Cumulative return	Correct ratio	Buying Signals
1	GBPUSD	-35.04%	42%	287
2	EURUSD	-9.36%	43%	276
3	AUDUSD	-6.53%	44%	262
4	NZDUSD	-8.96%	42%	277
5	USDCHF	-8.97%	44%	265
6	USDJPY	12.79%	61%	230

Note: Empirical period 2 January 2014- 31 December 2015

The table 4.7 shows trading performance the Moving Average Convergence Divergence (MACD) using two measures correct ratios and cumulative return, sex pair EUR-USD, GBP-USD, AUD-USD, USD-JPY, USD-CHF and NZD-USD. Table 7 shows the highest correct ratios is 61% for USD JPY and a lowest correct ratio is 42% for GBP-USD and USD-CHF, Highest cumulative return is 12.79% for USD JPY, the lowest cumulative return is -35.04% GPUSD.

Table 4.8 Return to Relative Strength Index (RSI)

	Pair	Signal	Cumulative return
1	GBPUSD	85	-0.01%
2	EURUSD	80	-0.07%
3	AUDUD	136	-0.07%
4	NZDUSD	67	0.14%
5	USDCHF	78	0.07%
6	USD JPY	93	0.11%

Note: Empirical period 2 January 2014- 31 December 2015

Table 4.8 shows the trading performance of the Relative Strength index (RSI) with the Cumulative return and trading signal. In this table, the highest cumulative return is 0.14% for the NZD-USD and the lowest cumulative return is -0.07% for AUD-USD and EUR-USD.

Figure 4.1 Simple Moving Averages for 5, 13, 50 and 200 Days of GBP-USD Pair

Note: Period Jun 2014-Dec 2015

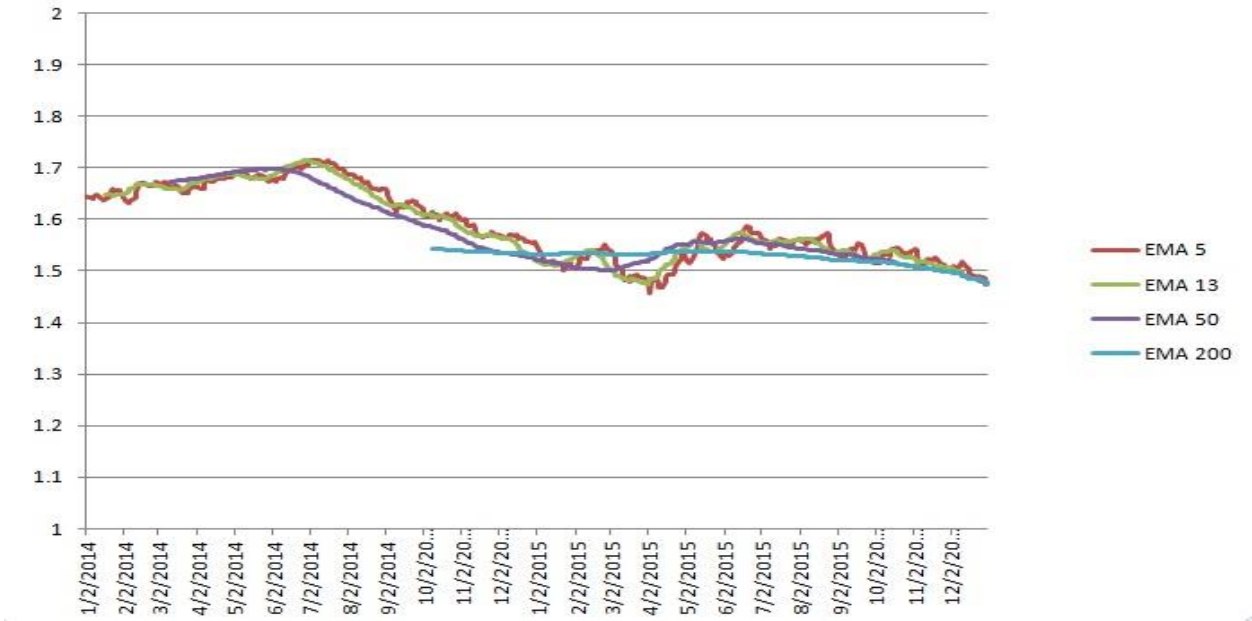

Figure 4.2 Exponential Moving Averages for 5, 13, 50 and 200 Days of GBP-USD Pair

Note: Period Jun 2014-Dec 2015

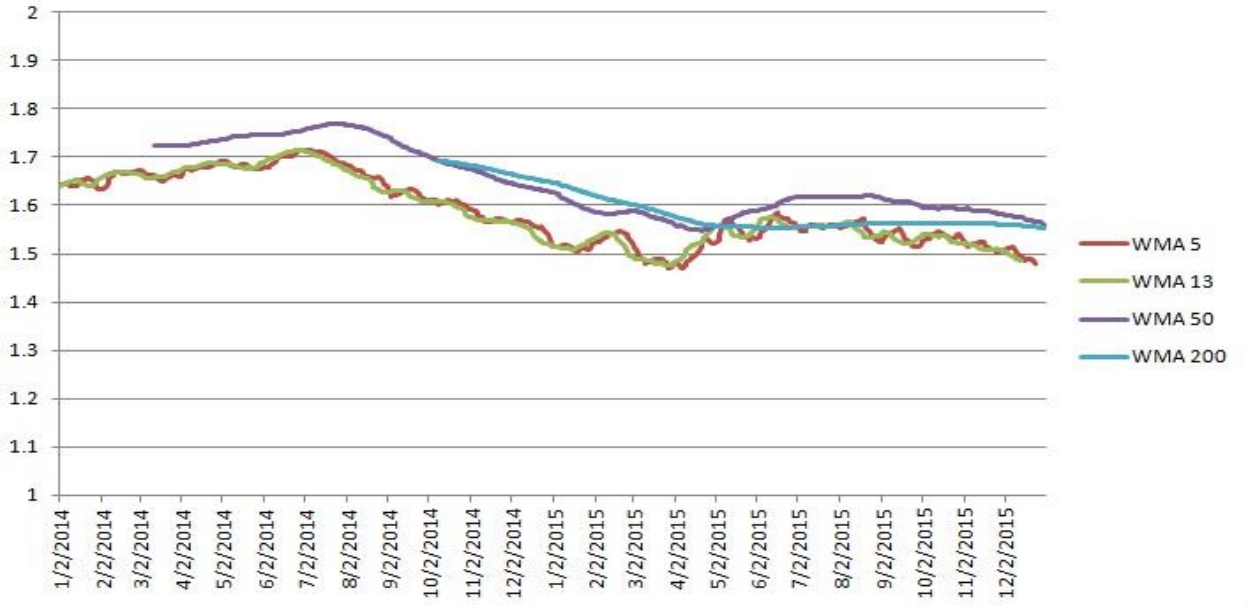

Figure 4.3 Weight Moving Average of 5, 13, 50 and 200 Days of GBP USD Pair

Note: Period Jun 2014-Dec 2015

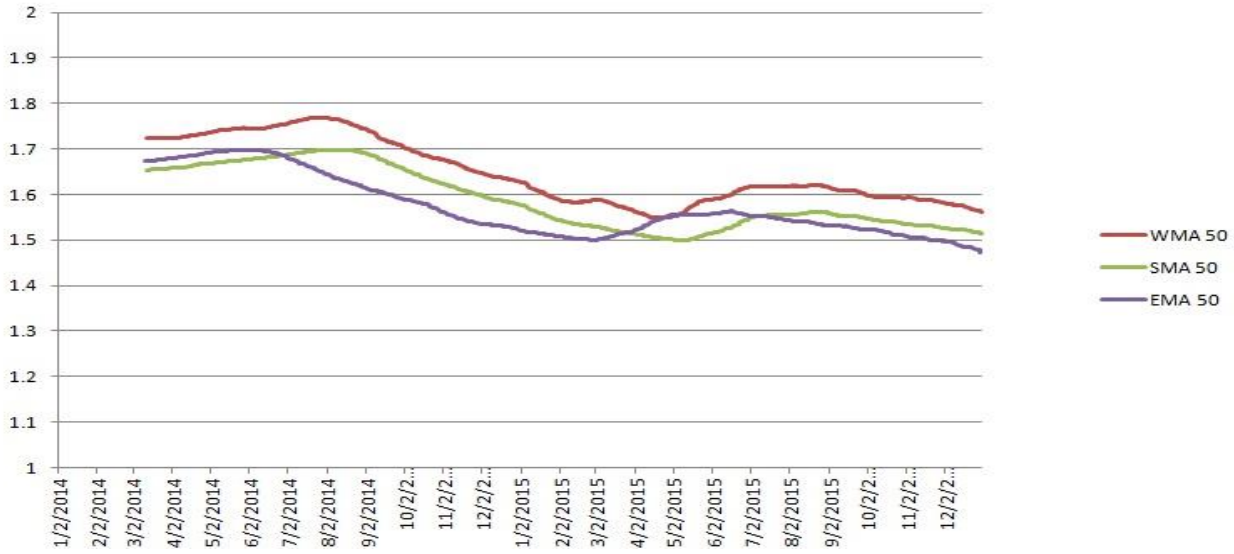

Figure 4.4 Differences of the 50 Days Moving Average WMA, SMA and EMA

Note: Period Jun 2014-Dec 2015

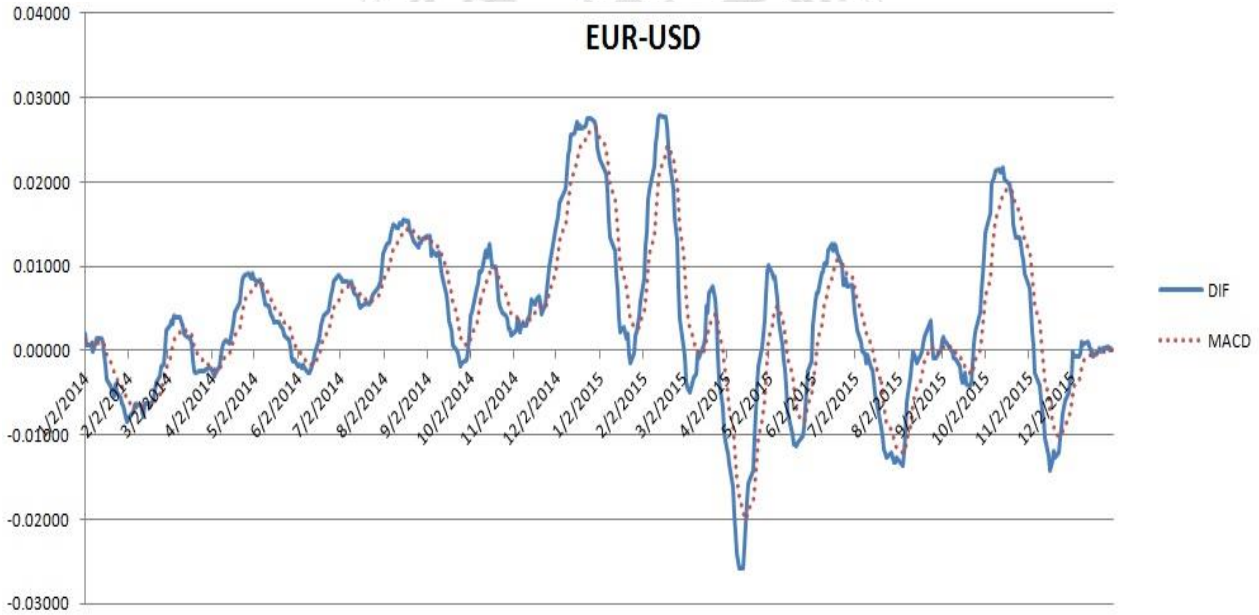

Figure 4.5 Differences of the EMA and MACD for the 12 and 26 Days of EUR-USD

Note: Period Jun 2014-Dec 2015

Figure 4.4 showed the difference of the EMA and MACD for the 12 and 26 days of the EUR-USD during the 2 years period. In this figure, the MACD chart consists of two elements. The first is the difference between 12 days and 26 days exponential moving average (EMA) of the closing price (Blue color), the second indicates the 9 days of the EMA: When the MACD line crosses the zero line; the buy signal generates and when the MACD line crosses below the zero line, the sell signal generates.

The highest currency fluctuation of the comparing of the six pairs in the MACD figure is USD-CHF. It is related to the news of interest rate because Swiss bank change the interest rate from -0.25% to -0.75%. So, the deposit of the banks in Swiss rose.

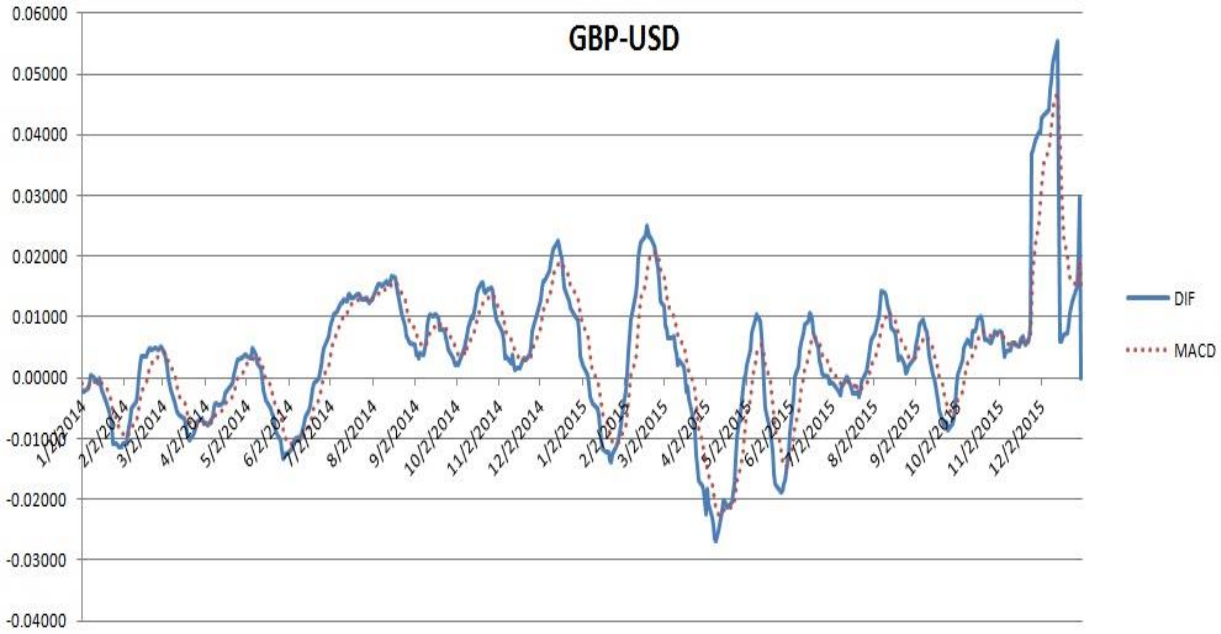

Figure 4.6 Differences of the EMA and MACD

for the 12 and 26 Days of GBP-USD

Note: Period Jun 2014-Dec 2015

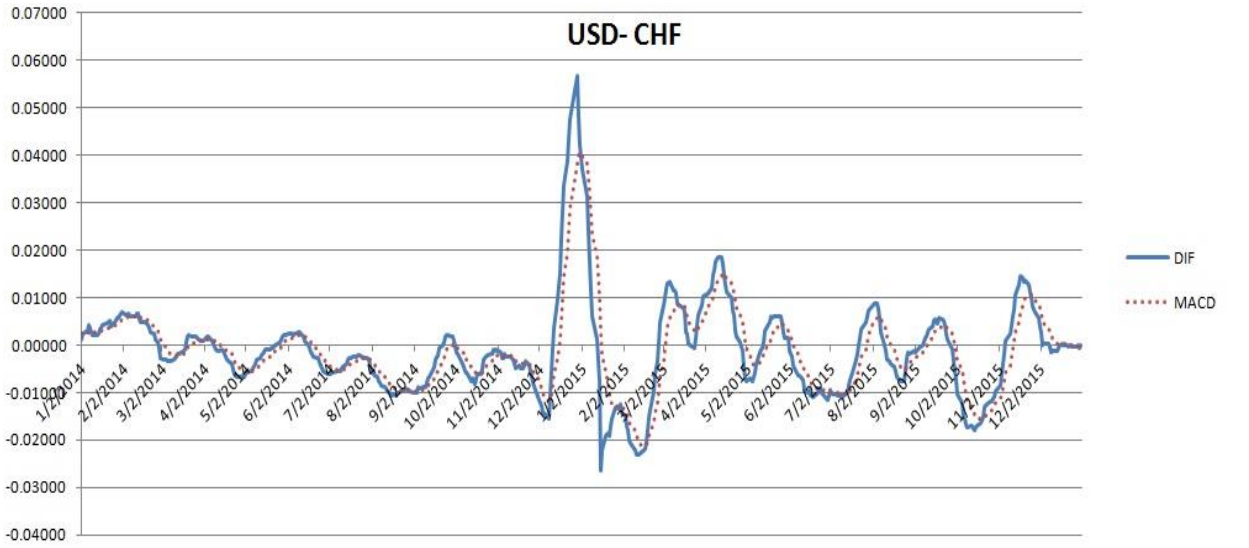

Figure 4.7 Differences of the EMA and MACD

For the 12 and 26 days of USD-CHF

Note: Period: Jun 2014-Dec 2015

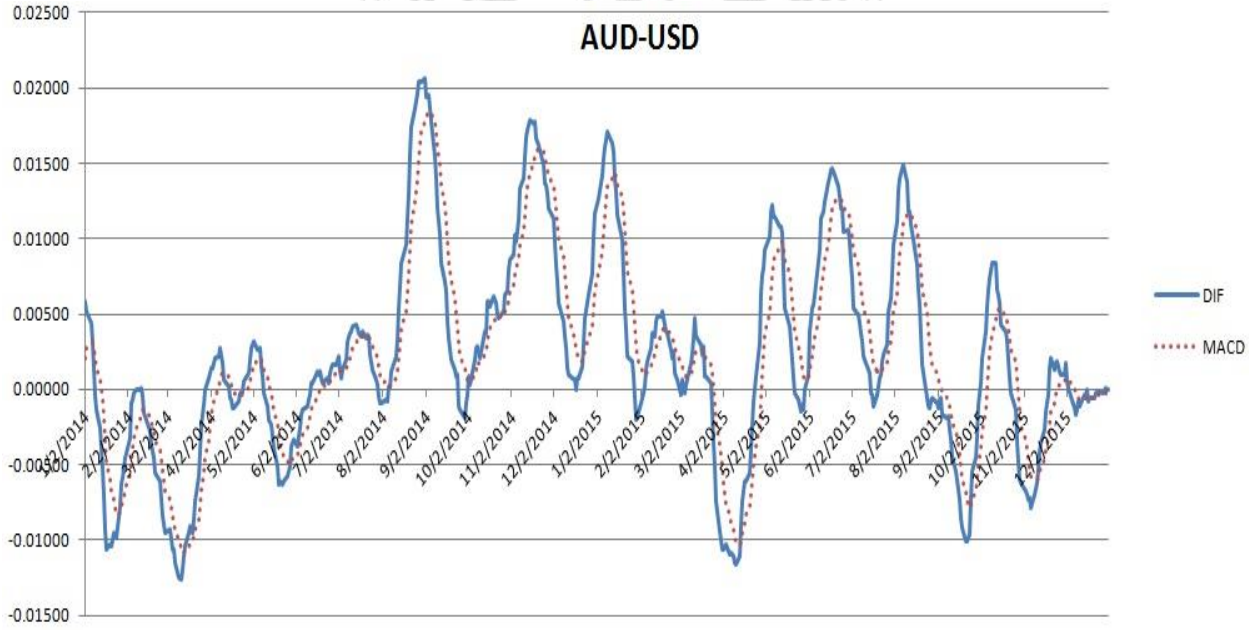

Figure 4.8 Differences of the EMA and MACD

for the 12 and 26 Days of AUD-USD

Note: Period Jun 2014-Dec 2015

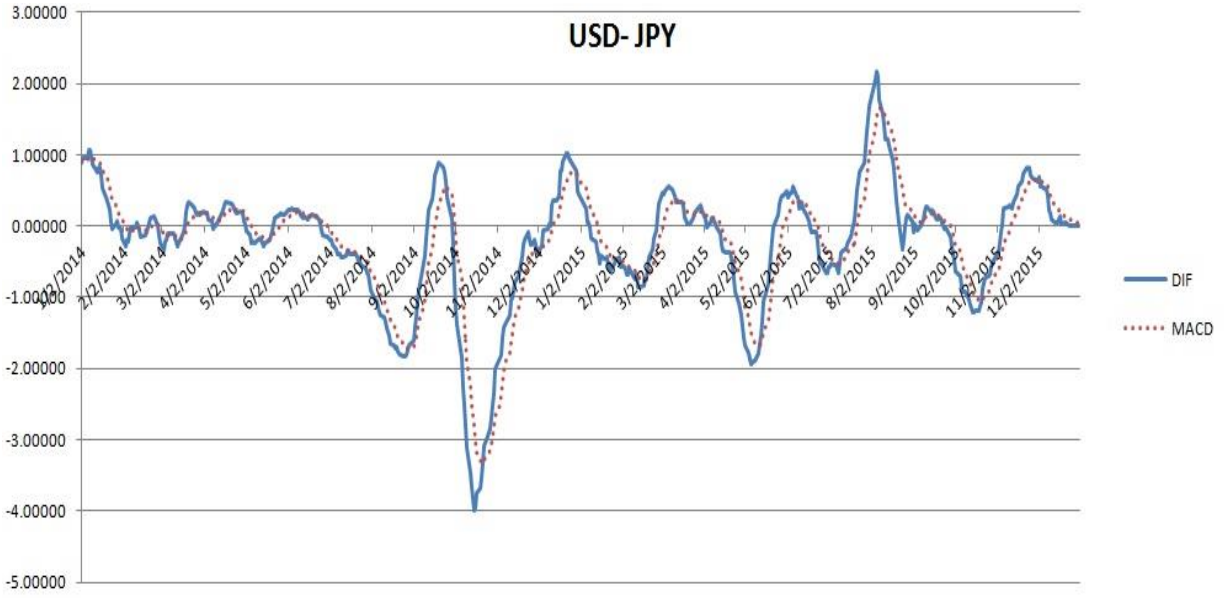

Figure 4.9 Differences of the EMA and MACD

for the 12 and 26 Days of USD-JPY

Note: Period Jun 2014-Dec 2015

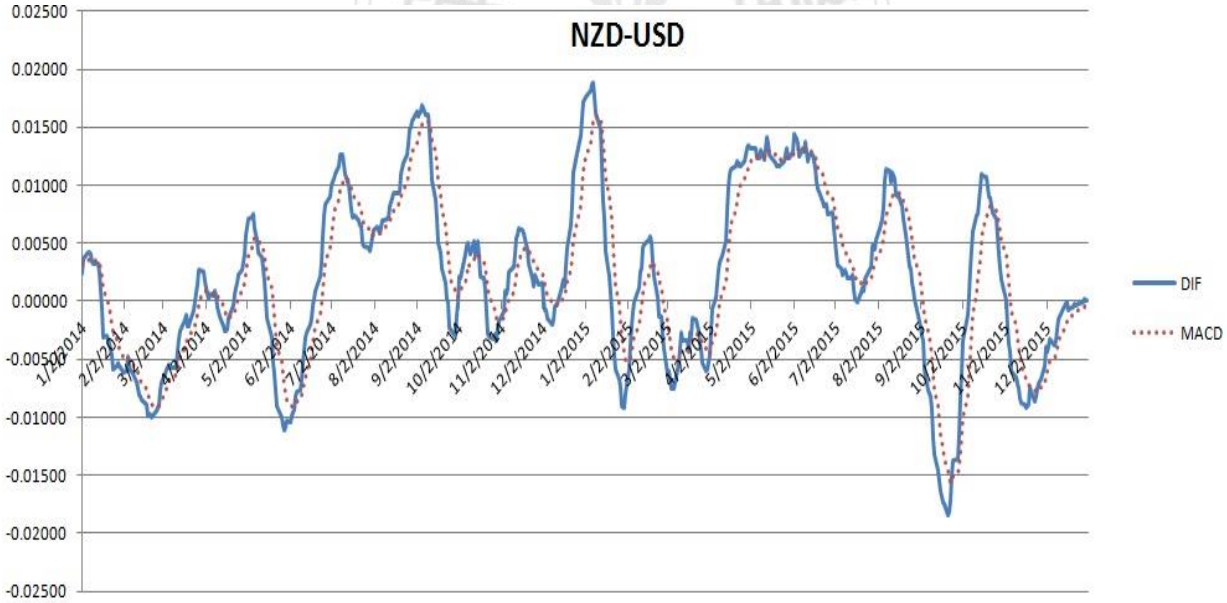

Figure 4.10 Differences of the EMA and MACD

for the 12 and 26 Days of NZD-USD

Note: Period Jun 2014-Dec 2015

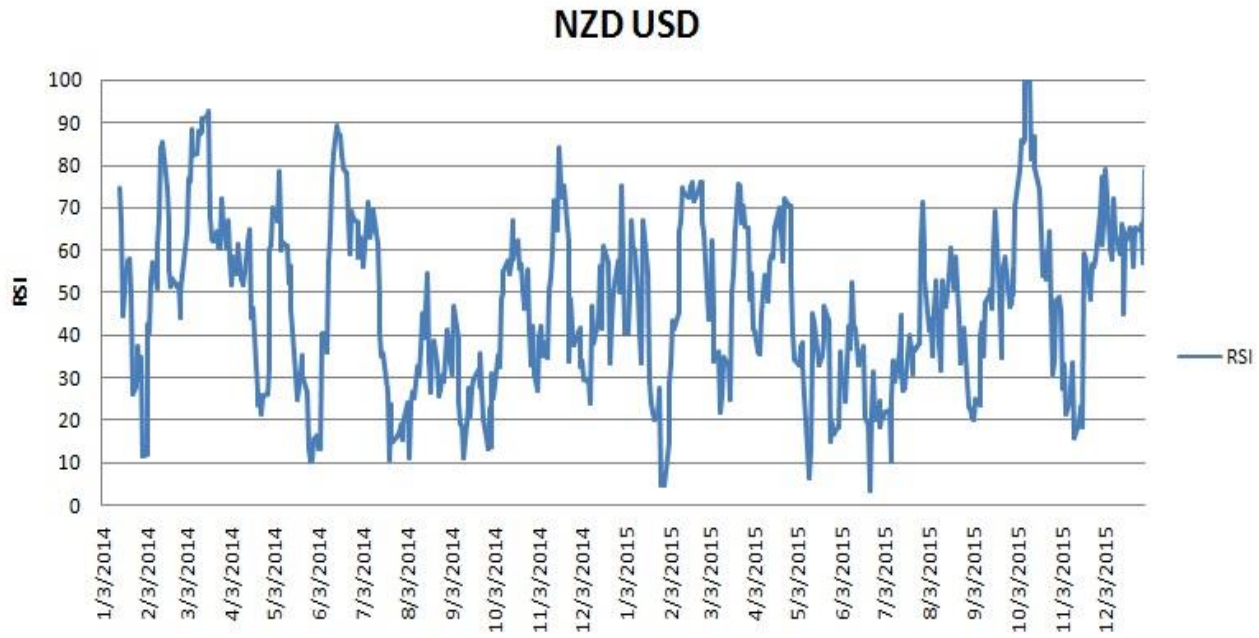

Figure 4.11 Relative Strength Index (RSI) for NZD-USD

Note: Period Jun 2014-Dec 2015

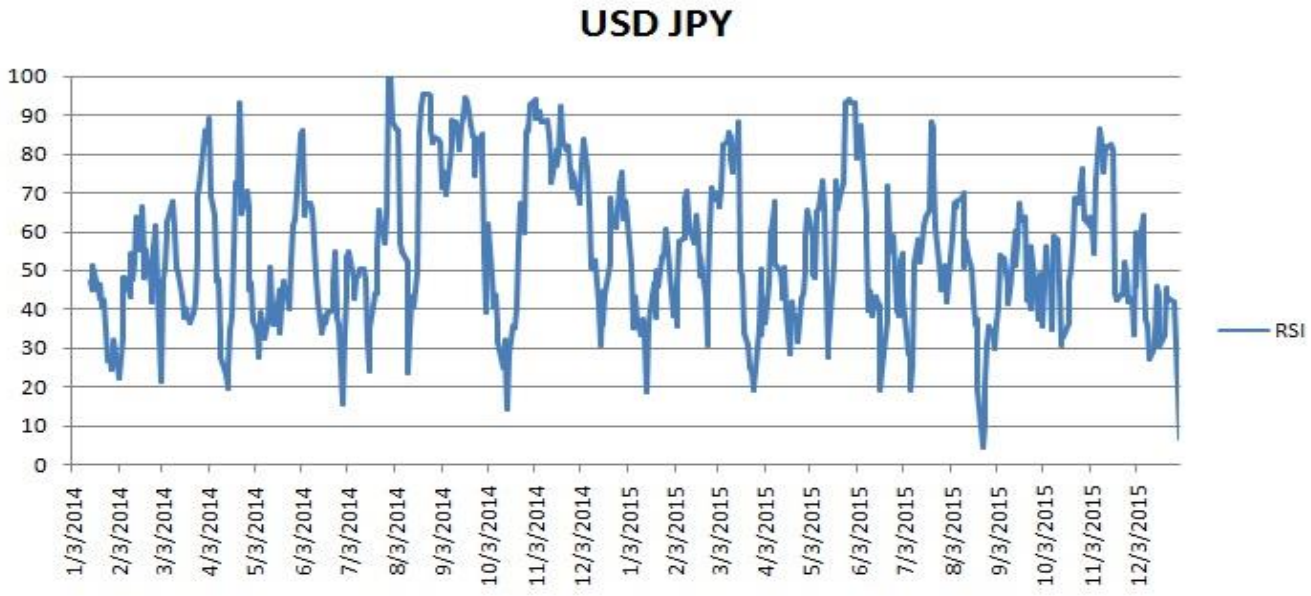

Figure 4.12 Relative Strength Index (RSI) for USD-JPY

Note: Period Jun 2014-Dec 2015

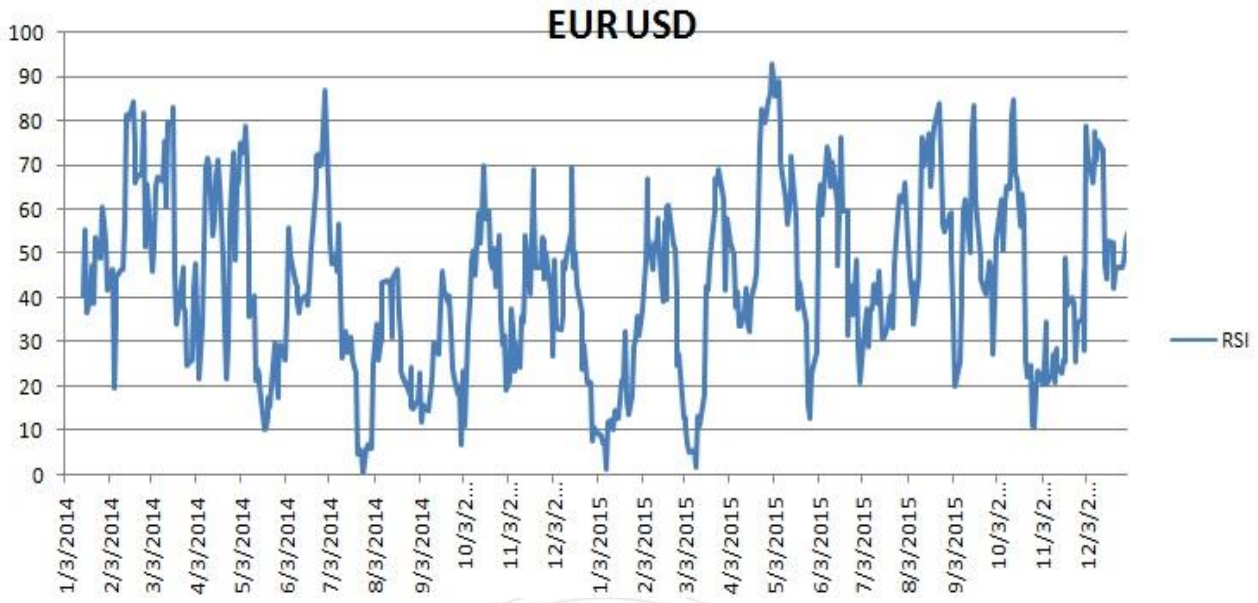

Figure 4.13 Relative Strength Index (RSI) for EUR-USD

Note: Period Jun 2014-Dec 2015

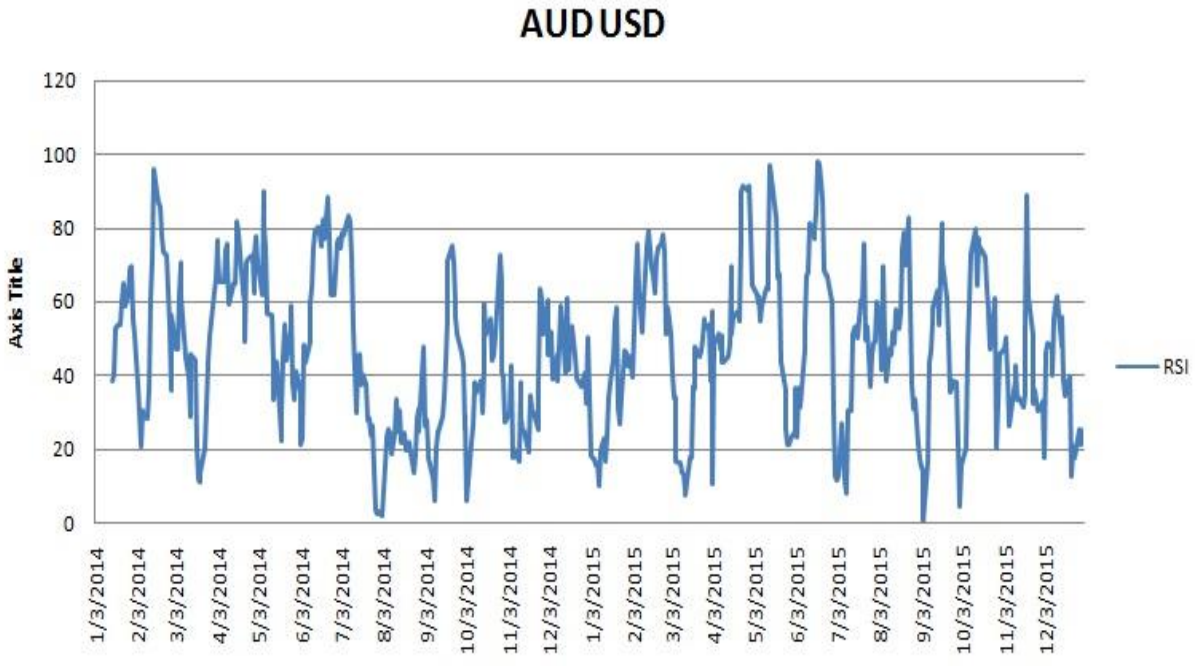

Figure 4.14 Relative Strength Index (RSI) for AUD-USD

Note: Period Jun 2014-Dec 2015

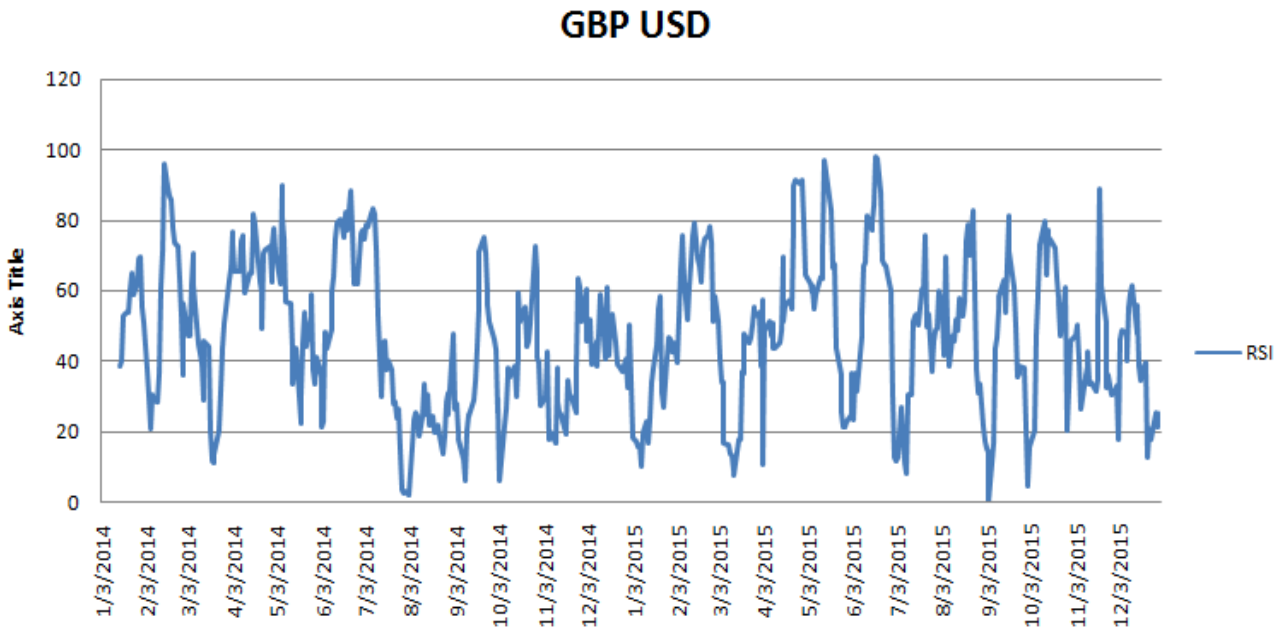

Figure 4.15 Relative Strength Index (RSI) for GBP-USD

Note: Period Jun 2014-Dec 2015

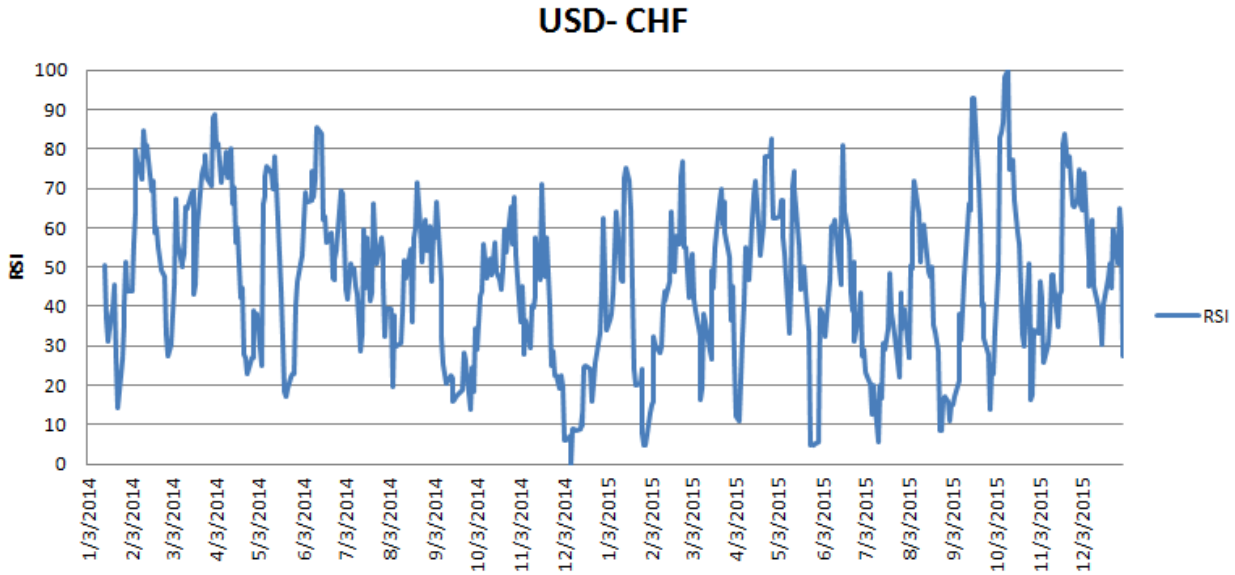

Figure 4.16 Relative Strength Index (RSI) for USD-CHF

Note: Period Jun 2014-Dec 2015

CHAPTER FIVE

CONCLUSION

5.1 Findings and Overall Conclusion

Technical analysis method studies that studies past price action for the purpose of forecasting future price movement due to it assume the historical price trend will be repeated in the future. The purpose of the study is demonstrating the trading performances of using the technical tools including the Moving average, MACD and Relative Strength Index (RSI) in forex trading. We try to make a comparison and find out which method performance is dominant to others on various criteria. In this study, we used to compare three indicators Moving average, MACD and RSI, and we studied that which indicator give the right direction (up or down) and cumulative return. From the result of Moving average, we found that three kinds of moving averages composition can give a right signal in the five pairs (EUR-USD, GBP-USD, NZD-USD, USD-CHF and AUD-USD. Because the correct ratio more than 50%, it means MA rule significant. In the result of the Moving average has shown that if the correct ratio positive, cumulative return negative. Only the correct ratio of USD-JPY is a negative and cumulative return positive. So, the moving average trading performance has shown the correct ratio is opposite to cumulative return. The moving average rules can give the investors right direction trend up or down. In this case of the Moving Average Convergence Divergence (MACD) trading performance, the five pairs (EUR-USD, GBP-USD, NZD-USD, USD-CHF and AUD-USD) correct ratio is negative and the cumulative return negative. Only USD-JPY corrects ratio is positive (60%) and the result of cumulative return is positive (12.79%). We found that MACD's trading rule works

in USD-JPY pair significant. From the result of the trading performance of the Relative Strength index (RSI), we can see that the RSI rule has the negative result and can't give high returns.

The comparing of the three MA's correct ratio is the weighted moving average and it is better than SMA and EMA. In particularly, the 13 and 200 of the weighted moving average are better. Also, the comparing of the six pairs MA 50: MA 200 gives more accurate signal than others. Especially, the correct ratio of AUD-USD and USD-CHF are better than others.

Comparing of those three indicators moving averages correct ratio is more than 50%, it is give a right direction for investors and traders. But in this result we showed that cumulative return most of them negative. However correct ratio predict of the market directions, it was not make a profit. It is explained that market have too noisy and also there have too much currency fluctuation.

We believed that the moving average method gives a right signal to investors or individual traders who are prefer to stand long position. The long days of sample period incorporated into the average price calculation and it will be better than short days of the sample period in the forex market. To find a right direction (uptrend or downtrend) in the forex market is the most important for the traders or investors.

5.2 Limitation and Suggestion Further Research

In this study examines the Moving average, MACD and Relative Strength Index (RSI) and six pair in the foreign exchange market. This study covered short period 2 years for examination of six pairs in the forex market and used daily closed data. Furthermore, we used only two measures compare for the three indicators. There are other more complicated tools and measure to investigate to the forex market. We suggest that using a high-frequency data and comparative another complicated method.

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