CHAPTER II
THEREOTICAL FOUNDATION

2.1 Artificial Intelligence

The development of artificial intelligence begins when we started to create machines and robots. In the beginning, machines are mainly used only for tedious and routine tasks. It left us with more complex and problem solving tasks. Machines and computers are excellent and fast arithmetic processors. On the contrary, pattern and image recognition is one of the most difficult task for machines, whereby for human, it will only take a fraction of a second to comprehend what is pictured in the image.

With the advance of computer's processing power, there have been studies to embed the enormous processing power with the flexibility of biological neurons, ultimately the brain. Many of these AI tools are developed as an attempt to solve logical problems such as forecasting and interpretation of financial market data to make an intelligent decision.

2.2 Artificial Neural Networks

ANN models are computational methods which are inspired by the function of biological neurons. ANNs is build of many interconnected units, called neurons, which performs simple logical operations. Zurada (1992) explains that

ANNs try to simulate the human's brain biological neural network, which enables complex tasks to be performed instinctively.

2.2.1 Components of a Neural Network

- Processing Elements are artificial neurons which will receive inputs, process the inputs, and send out an output.
- Networks are group of processing elements in form of layers.
- Network Structure in ANN can be constructed in many ways. The neurons may be interconnected in different ways, as is the number of network layers.

2.2.2 Information Processing in the Network

The process starts with a collection of inputs, with each input correspond to a single value or attribute. They are then feed into the next parallel nodes which will weigh the entering data as it is transferred layer to layer. The weight is actually a value of relative strength which translate into how important the input to the corresponding processing element.

2.2.3 Learning Process

Characteristic of an ANN is its ability to learn from mistakes. The most common and straight-forward process of learning involves:

- Compute outputs
- Compare outputs with desired value
- Adjust the input weights and repeat the process

During the learning process, the model will response input feed into the system by change the weights until a certain level of fitness is achieved.

2.2.4 Benefits and Weaknesses of ANN

The benefits of ANN are fault tolerance, generalization, and adaptability. With many layers and connections that build an ANN, minor outliers in the input data will not affect the quality of the output. It is also able to cope with noisy or incomplete inputs and still generate a reasonable output.

ANN also has limitations in which it may not be suitable for every potential application. It may omit or include evident non-desirable factors which may alter the performance of the model.

2.2.5 Hidden Layer

One of the characteristics which make ANN unique is the hidden layers, which are actually transparent layers between the inputs and the

outputs nodes which does the weighted sum calculation between the inputs before passing it out to the next nodes.

2.3 High Frequency Data

Financial market is the natural source for the use of high frequency data. Market data containing units of information such as price, volumes and trading position are transmitted across market participants with irregular space between them. Instruments which are very liquid, such as foreign exchange quotes, can generate hundreds of thousands of tick-by-tick data per day.

Yet Neely and Weller (2009) points out that there is a time horizon mismatch between the practical technical analysis with academic studies. Studies often use a rather longer horizon such as daily, weekly or monthly data while in reality, intra-day trading are mostly based on tick-by-tick movement of trading prices as it is executed in the market.

There are at least two main reasons for the time mismatch. First, the effort of collecting, storing, retrieving and compiling high frequency data can be costly and time consuming. Hence, most available financial data comes at lower frequencies, such as daily closing. Second, most of the statistical methods that are being used to study market data have been developed for data assumed to be equally spread over the time series.

Dempster et al (2001) applies use of high frequency data in their artificial intelligence model, and their models have shown evidence of outperforming the heuristic and non-generic algorithm approach. Hence, they concluded that there is indeed useful information in the technical indicator data that can be used for intra-day trading strategy.

2.4 Technical Indicators

Technical indicators may be described as series of data which are calculated from price data of the security. The price data may include the open, high, low and close prices which are often referred to as OHLC price. These series of data are then plotted into graphical form for easy visual scan. Hence, based on these graphical representations, TA traders can quickly note a price action, confirm a breakout, predict the price direction and take a trading position accordingly.

Technical analysis practitioner does not rely on only one type of indicators. There is no definite combination of indicators, nor there exact rule with which the trade will be profitable. They would take into consideration other indicators to confirm a trading signal before closing the deal.

Several popular technical indicators will be used in this study to utilize the characteristics of the ANN which is non-linear and does not care about dependency between the variables.

2.4.1 Price Channel

Price Channel (PC) is a simple trading indicator which is often drawn overlaying the current price. For a certain period, the upper channel would define the highest price which had been achieved during the period whilst the lower channel would define the lowest price.

The PC is a historical indicator and does not include the most recent period. If current price breaks over the upper channel or below the lower channel, then it can be used as a signal of trend reversal or overbought/oversold condition.

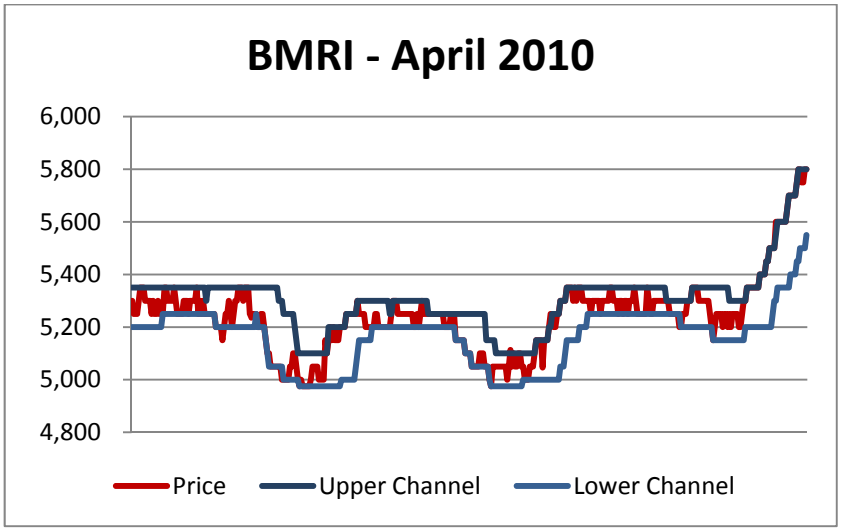

Figure 2.1 Sample of Price Channel Indicator

2.4.2 Adaptive Moving Average

The Adaptive Moving Average indicator (AMA) is a modification to the conventional moving averages in that it has different sensitivity related to price volatility. If the price is choppy and volatile, the AMA will be less reactive. But when the momentum is strong with certain direction, the AMA will be more sensitive. This feature makes AMA may sound more appealing since it is expected to ignore small noise volatility and to only give signal when the trend is confirmed.

However, it has been found that the additional complex calculation does not yield sufficient practical advantage to win this method over the other simpler moving averages.

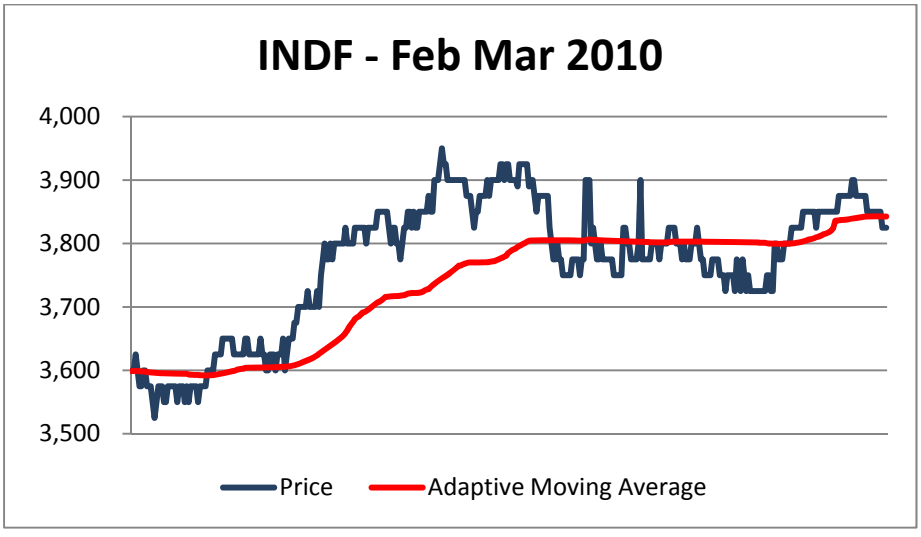

Figure 2.2 Sample of Adaptive Moving Average

2.4.3 Relative Strength Index

The Relative Strength Index (RSI) is a momentum indicator which measures the speed and the price movement change. RSI may vary between 0 and 100, with the lower number indicates that the instrument is oversold (time to buy) and the bigger number is an indication of overbought (time to sell).

The RSI was developed by J. Welles Wilder in 1978 and has become one of the most popular indicator because it is easy to calculate yet quite powerful to predict a bullish and bearish market.

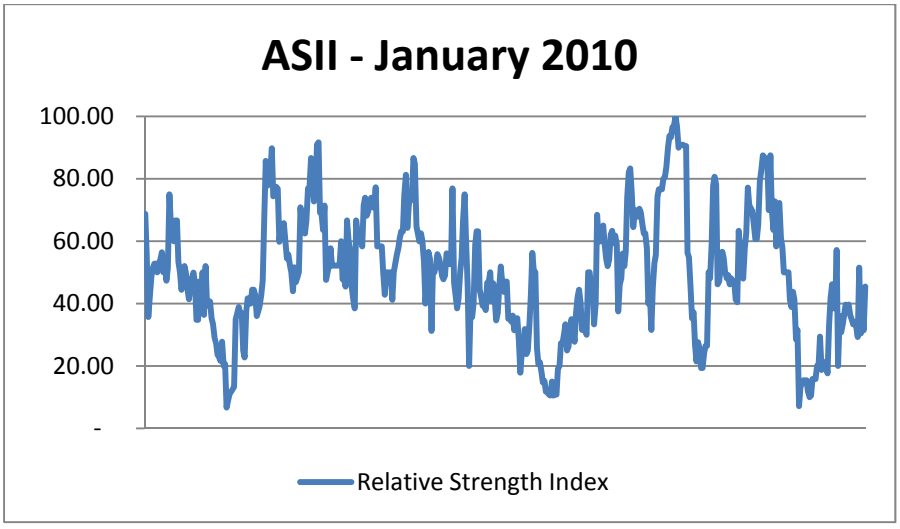

Figure 2.3 Sample of Relative Strength Index

2.4.4 Stochastic Oscillator

This indicator has unique characteristics in that it does not follow price or volume, but it closely resembles the speed of the price. Hence, many analysts use this as a momentum indicator to forecast price reversals. Stochastics was developed by George C. Lane in the late 1950 in his effort to identify a trend build up and future trend reversals.

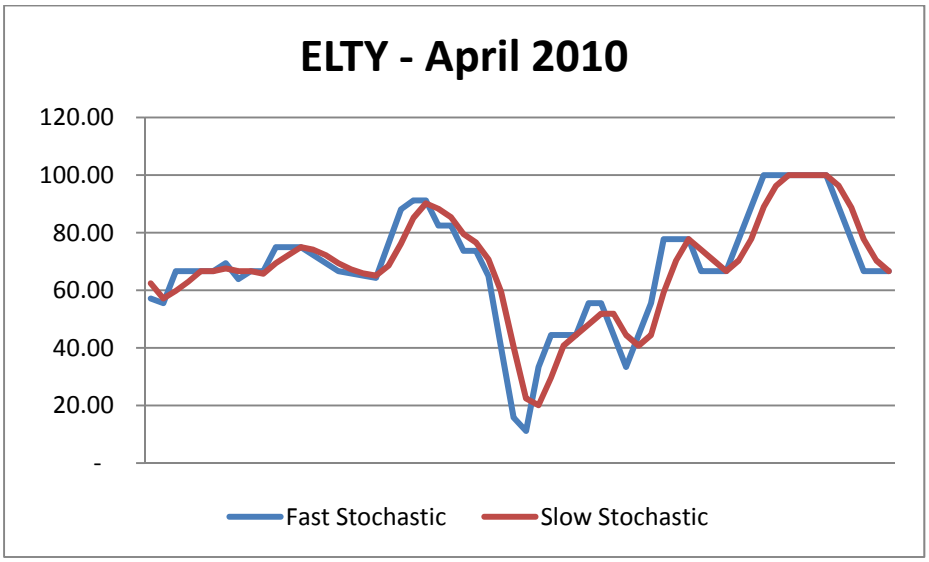

Figure 2.4 Sample of Stochastic Oscillator

2.4.5 Moving Average Convergence-Divergence

The Moving Average Convergence-Divergence (MACD) is also a very popular indicator, because it gives a momentum signal and sense of trend direction. Traders use two kinds of graph observation to decide the trading signal with MACD; by looking at the crossovers

between the MACD with the signal line, and at the divergence or convergence points.

The signal line is basically an exponential moving average (EMA) line with period which is relevant to the time horizon of the trading. The normally used one is 9-period EMA. Convergence, which is a signal to sell, is occurred when the shorter EMA crosses below the longer EMA when the MACD value is positive. On the contrary, divergence occurs when the shorter EMA crosses the longer one with negative MACD value. This is a buy signal.

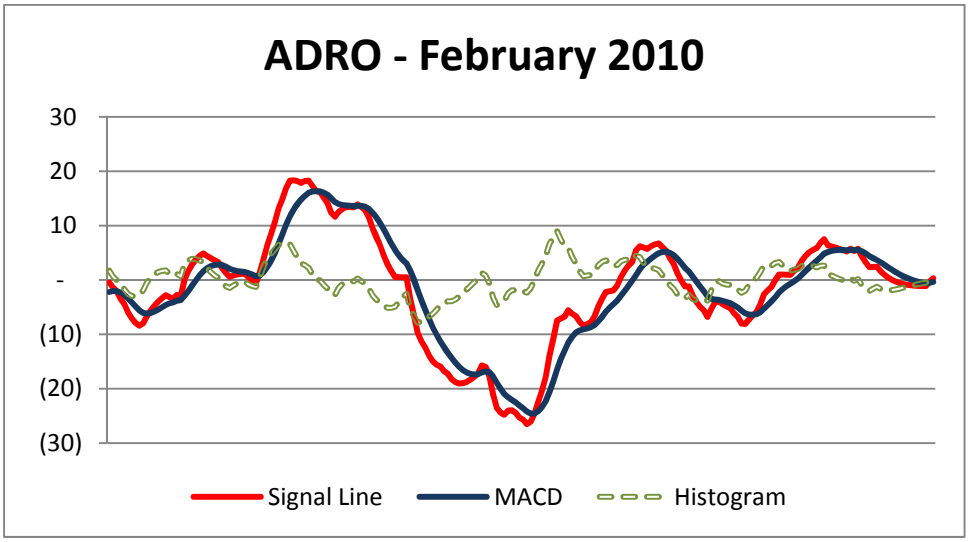

Figure 2.5 Sample of Moving Average Convergence-Divergence

2.4.6 Moving Average Crossovers

Moving averages (MA) are the trend following indicator which are easy to construct. However, traders must always take in mind that

moving averages will always lagging with the current price. Hence at best, moving averages are good to confirm trading signals from other indicators.

Buying signal comes when the faster MA crosses from below to above the slower MA, while the selling signal is the opposite, faster MA crosses from above to below the slower MA.

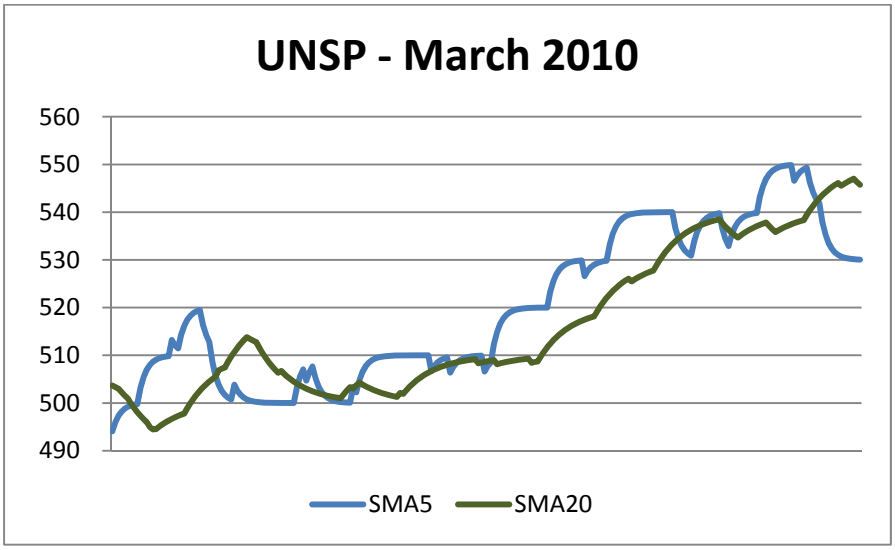

Figure 2.6 Sample of Moving Average Crossover

2.4.7 Commodity Channel Index

This indicator was developed by Donald Lambert in 1980 to identify new trend and to serve as a warning of extreme conditions. It measures the current market price relative to the average price over a period of time. If the price is far higher than the average, the CCI will show a

high value, and when the price is lower than average, CCI will reflect it as low value as well. Hence, it can be used as an indicator of overbought and oversold levels.

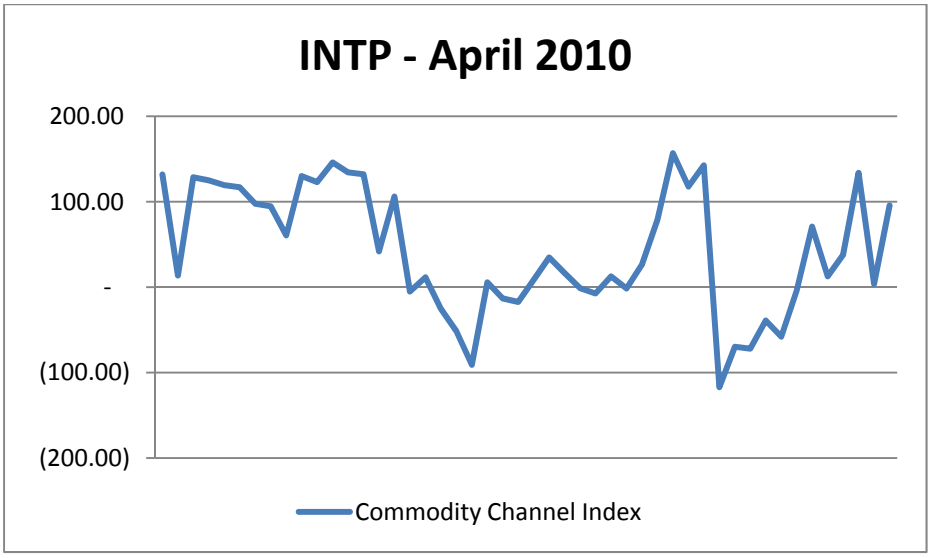

Figure 2.7 Sample of Commodity Channel Index