# Technical Analysis of Trading Rules in Stock Market Within FTSE 100 Stock Data

By

**Yunzhe Yang**

Bachelor of Information Science

June 2010

A Dissertation

Submitted in partial fulfillment of the requirements for the

Master of Science

Centre for Computational Finance and Economic Agents

University of Essex

September 2011

# ABSTRACT

The objective of this paper is to analyze trading rules with technical factors from stock market. All the study based on the data from FTSE 100 stock data. There are three main steps in this study: the evaluation of Gann's trading rule with confusion matrix, deep technical analysis of stock market with more considerations, and the generation of new trading rule with the extra limitation of trading volume and retesting of the new rule. The comparison between Gann's trading rule and the new one show the improvement of the new rule in performance and efficiency in stock market. At the same time, the conclusion proves my study is useful in some extent.



**KEYWORDS**: Trading Rule, Evaluation, Technical Analysis

# Acknowledgements

I am heartily thankful to my Supervisor, Professor Edward Tsang, whose encouragement, supervision and support from the preliminary to the concluding level enabled me to develop an understanding of the subject.

It is also a pleasure to thank who made this thesis possible suck as my parents who gave me the moral support I required.

Lastly, I offer my regards and blessings to all of those who supported me in any respect during the completing of the dissertation.

Yunzhe Yang

# Table of Contents

# 1. Introduction

## 1.1. Picture of Technical Analysis

Survived from a period of being contempt, technical analysis has been taken into account by both practitioners and financial econometricians in current financial market trading techniques (Terence, 1997, p 319). Technical analysis of financial market with finding patterns not only supply the prediction of underlying asset future prices, but also provide investing or trading suggestion according to the price movements in history from visual examination (Edwards and Magee, 1967). In fact, these can be achieved with the support of certain quantitative summary measures of past price movements such as ‘momentum’ indicators (‘oscillators’) or moving averages (Murphy, 1986). Technical analysts make efforts to test the history prices and do relevant statistics on security trading in order to gain the information of future price movements. Most of analysts put their faith on the process of change between supply and demand, which is reflected in the generated graphs from market action. Generally, technical analysis has referred to a large amount of fundamental trading analysis since from 1800s. (Brock-Lakonishok-Baron, 1992, p 1731)

One typical descriptions of the role of technical analysis plays in academic aspect was proposed by Malkiel (1981). He stated that technical analysis is not a good sign to the academic area. Moreover, analysts who strongly against it consider that the approach of technical analysis is completely fake, at the same time, it can be criticized easily.

Nevertheless, technical analysis has experienced a renaissance on Wall Street, so that a myriad of study and publish about financial market and security trading are in the technical way (Brock-Lakonishok-Baron, 1992, p 1732). In addition, as the high frequent movements in stock prices that an increasing number of nonlinearity has been found in time series, which exactly is what technical analysis required (Terence, 1997, p 320).

### 1.2. Background of Gann's Trading Rule

What I should mention is the trading rule which I am going to use and test is from Gann's trading plans. This rule was created based on a general trading plan which includes five main points: (Robert- MH-BCHE, 2005, p 3)

(1). the direction change of market (such as general change trend)

(2). the valuable price movements (in other words, tradable trend changes)

(3). the indispensable support and resistance points

(4). the market trading points

(5). the risk management at least includes sufficient money, stop limits, profit guarantee and invest weight of capital on each trade

While, after considered all above points and combined them into a practical trading strategy, it is much necessary to test and evaluate its efficiency in stock market. Generally, analysts would like to pay attention on three aspects during the testing process, such as philosophy foundation, robustness and dynamics. Firstly, this trading

plan has to be fully applicable to stock market and covers three characteristics, including statistical, algorithmic and time oriented. Secondly, robustness is one of the main targets to any program designer. Especially in stock market, the robustness of a trading rule has an extremely effect on the actions of traders. Then, dynamics should be mentioned in the testing part of trading strategy; which means all of the trading rules must be dynamically to follow the speed of market change. (Robert- MH-BCHE, 2005, p 4)

Although, the trading rule I choose is a very basic one, be commonly used. This is not only because it satisfies such three key points have been mentioned above, but also it runs steadily, performs attractively in current stock market and in some extent be able to make profits. (Robert- MH-BCHE, 2005, p 5)

### 1.3. Aim and Target

As technical analysis has been accepted and used widely in trading market, the study of trading rules in performance and efficiency has become a hot topic in financial system. In this paper, I am going to concentrate on two main aspects, one is how Gann's trading rule (Rule 1) runs with 40 popular stocks data from FTSE 100 index and be tested by using confusion matrix within the programming returns, and the other is how some other factors take into account during the further technical analysis process so that obtain some useful information to improve Rule 1 in a reasonable way. On one hand, I would like to define and explain the regulations of Rule 1 clearly in

the programming part, turn them into code on the platform of Matlab, and use end of day data from FTSE 100 stock data as my database to get returns. After gaining the returns, testing them in the technical way is one of the key points of this paper. The essential method of assessing the trading rule is confusion matrix which reflects the performance and efficiency of Rule 1 from an academic angle. Confusion matrix is a technical approach to analyze the efficiency by calculating the parameters in this method, such as correctness, precision and recall. Each parameter has own meaning which I will explain in following part. On the other hand, further analysis is the other essential aspect of this paper, which refers to different chart patterns, trading volumes and stock volatility. I suppose to figure out the relation and interaction among these factors so that help me to improve Rule 1 and generate a new trading rule (Rule 2), and then retest the Rule 2 not only by using confusion matrix but profits to prove the more efficiency and better performance of it.

## 2. Methodology

### 2.1. Data

FTSE 100 index, which was set in January 1984, includes the top 100 blue chip stocks in UK and is weighted by market value. FTSE 100 index includes about 82.37% of capitalization in the UK market which refers to funds, derivatives and exchange traded funds (ETFs). The 100 companies are prominent as their largest size, highest liquidity and biggest influence in financial market, whose market preference is

reflected by FTSE 100 index exactly. All of these stocks are running under the London Stock Exchange's SETS trading system. (FTSE, 2011)

According to these 100 high capitalized companies' market prices, I choose 40 stocks randomly in the type of end of day data. It provides low and high prices, close prices, and trade volumes of each stock in each day (see Table 1 in Appendix).

### 2.2. Definition of Gann's Trading Rule—Rule 1

#### 2.2.1. Hilo Activator

In this trading strategy, Hilo Activator is a basic tool which is used as a trigger for trading entry. It is set up based on moving average (three days moving average in this study). It supplies four factors sell stop, buy stop, highest price and lowest price. Firstly, sell stop is the average of the previous three periods' low prices, and follows the uptrend of market. In other words, according to the three days moving average and end of day data, sell stop (see Table 2, the second column in Appendix) is calculated with the average of every three days' low prices. It is plotted as a horizontal line on each three days' Hilo Activator bar at the bottom which is showed in Figure 1. Sell stop only runs during the upward trend market. Then, buy stop (see Table 2, the third column in Appendix) is measured by the average of three high prices in every three days, and showed by another horizontal line on the bar but at the top (see Figure 1). It works during the downtrend. The third is the highest price, which is the highest price during each three days among high prices (see Table 2, the forth column in Appendix),

and plotted as the top of each bar in Figure 1. Similarity, the lowest price is the lowest low prices in each three days showed in Table 2 the fifth column in Appendix, and located at the bottom of the bar (see Figure 2). (Robert- MH-BCHE, n.d., p 2)

Generally, in the stock market trend, the sell stop should lower than the market close price, which means sell stop can be plotted as a horizontal line on the Hilo Activator bar when it is lower than the market close price. Once the market close price below the sell stop, the buy stop horizontal line will appears on the bar. At the same time, Hilo Activator shows that stock market is following a tendency in a long time series, which depends on the higher or lower price step by step. (Robert- MH-BCHE, n.d., p 2)

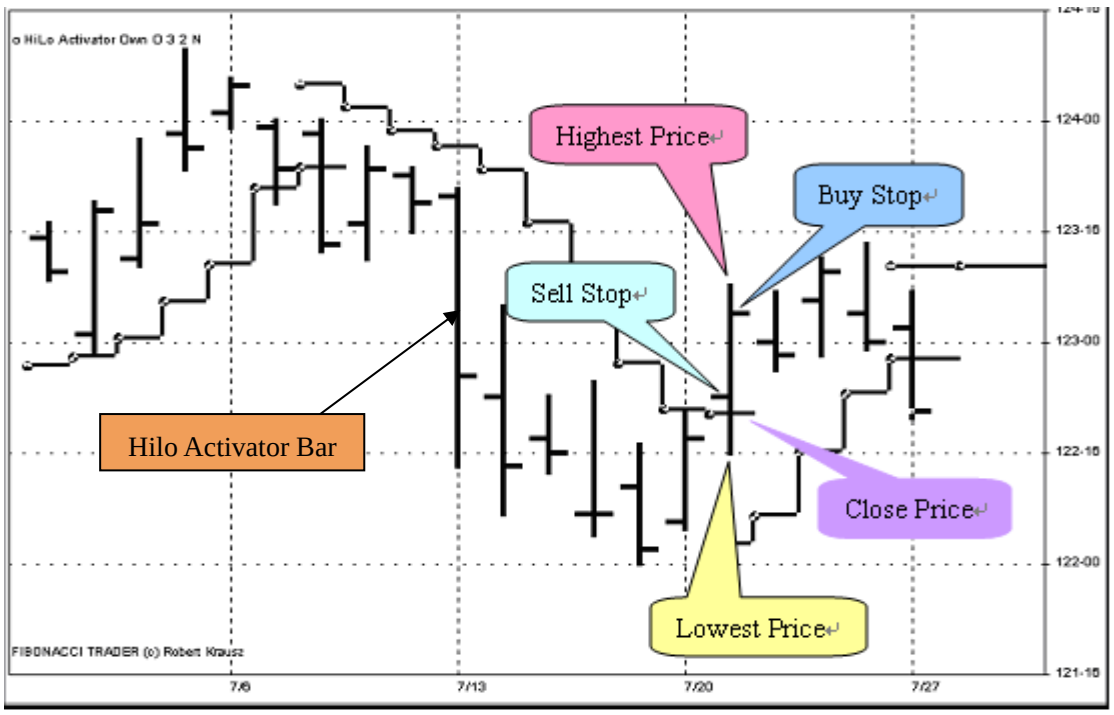


Figure 1 (Robert- MH-BCHE, n.d., p 2)

The returns I get from the code in Matlab of Hilo Activator are showed in Figure 2

and Figure 3 (one enlarged section of Figure 2). Figure 2 shows the overall results of the Hilo Activator. Figure 3 exhibits the four factors belong to Hilo Activator: sell stop (green points), buy stop (red points), highest price in every three days (black points), lowest price in each three days (yellow points), and the close price each three days (blue line).

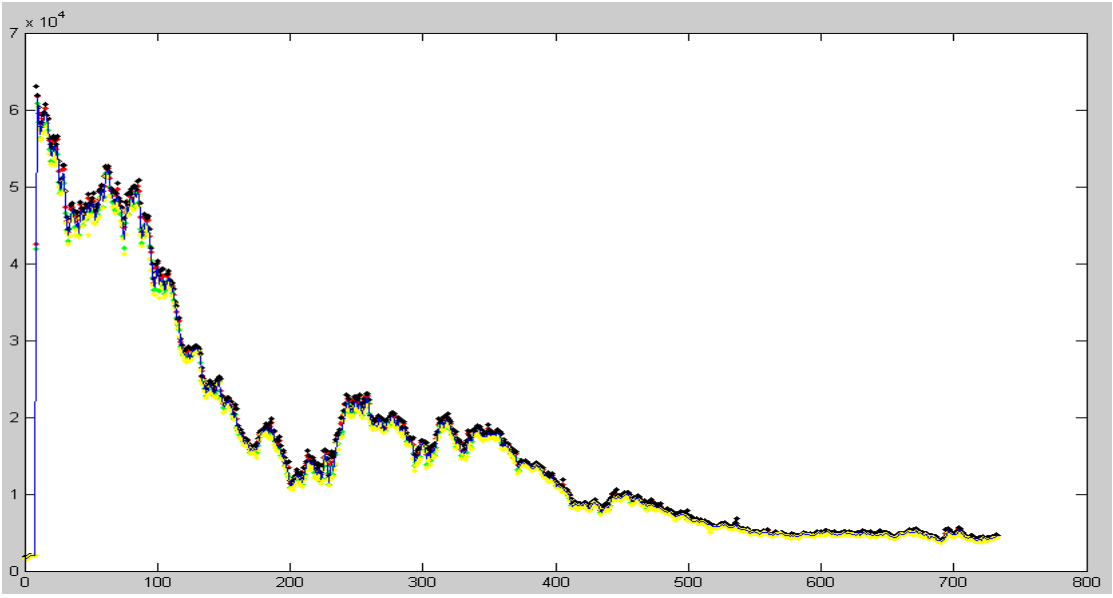


Figure 2 (from company Aggreko)

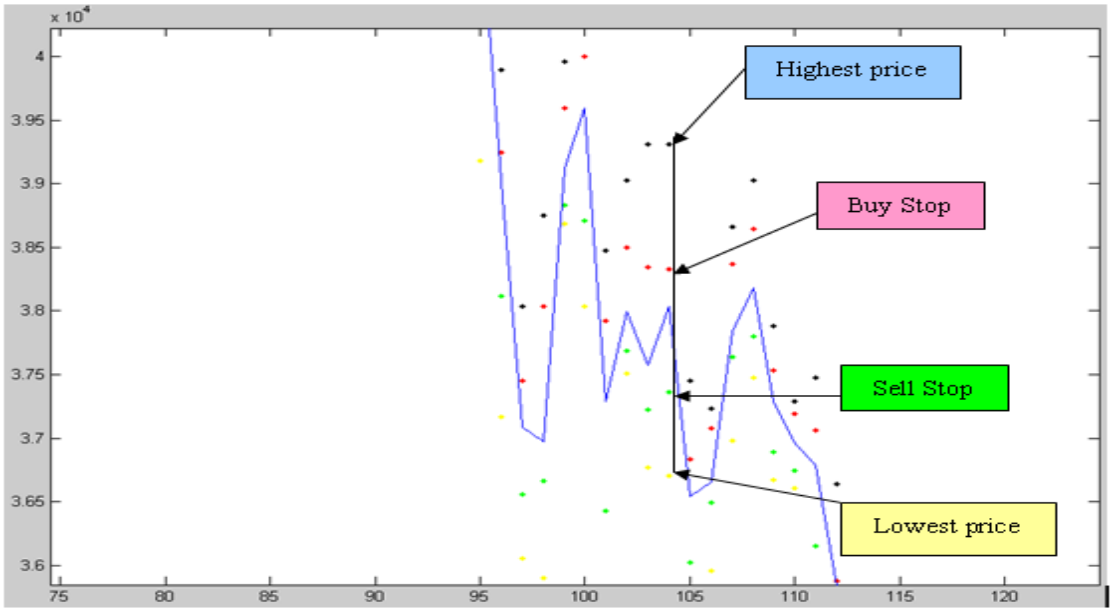


Figure 3 (one enlarged section of Figure 2)

### 2.2.2. Rule 1

Before I define the trading rule, there are some fundamental limitations. Robert (2005, p 29) states: “In long entry, Gann Swing Chart must show an uptrend; bar must close above Hilo Activator. In short entry, Gann Swing Chart must show a downtrend; bar must close below Hilo Activator”. This statement will be explained further in the following section. In addition, we define every three days as one tick period.

Rule 1 in Long Entry (see Figure 4) (Robert- MH-BCHE, 2005, p 30):

(1). There must be an upward trend appears in the time series.

(2). Directional change helps us to report the valleys as last low prices in the whole period.

(3). From each last low point, we go forward by two ticks and stop at bar A, and then compare the three market close prices with the value of buy stop on Hilo Activator bar A. If one of the three close prices is higher than the buy stop, we make trading decision to buy at that close price, and report the corresponding last low point as one confirmation point. Otherwise, go to next last low point and repeat the whole process.

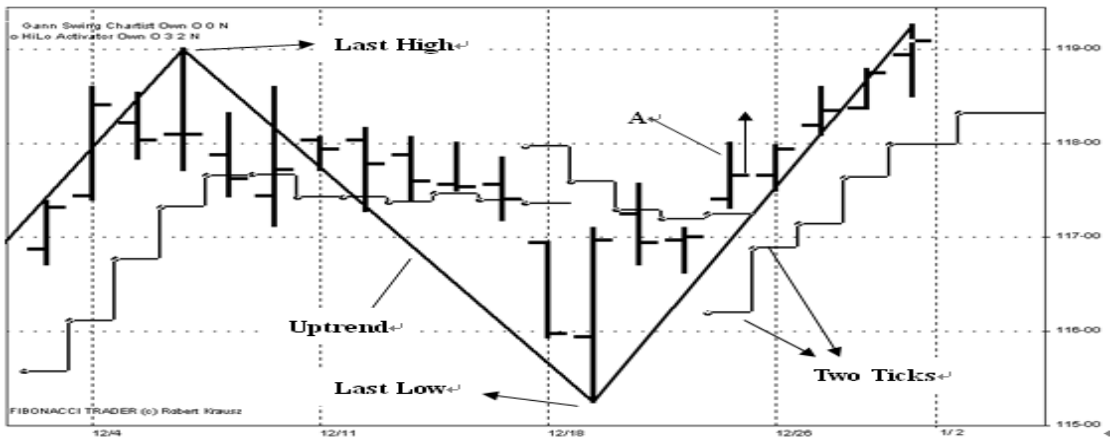


Figure 4 (Robert- MH-BCHE, n.d., p 3)

Rule 1 in Short Entry (see Figure 5) (Robert- MH-BCHE, 2005, p 30):

(1). There must be a downtrend appears in the time series.

(2). Directional change helps us to report the peaks as last high prices in the whole period.

(3). From each last high point, we go forward by two ticks and stop at bar A, and then compare the three market close prices with the value of sell stop on Hilo Activator bar A. If one of the three close prices is lower than the sell stop, we make trading decision to sell at that close price, and report the corresponding last high point as one confirmation point. Otherwise, go to next last high point and repeat the whole process.

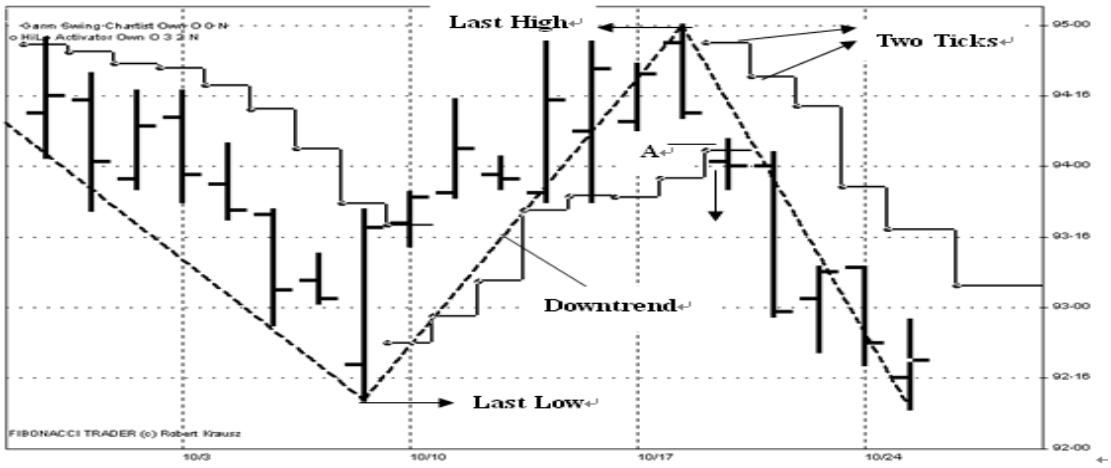


Figure 5 (Robert- MH-BCHE, n.d., p 3)

It is essential to translate the trading rule into Matlab code exactly based on all of the regulations which belong to the rule. Firstly, in the time series, I find and record the lowest price points and highest price points. Secondly, use directional change to find the last low prices and last high prices separately (see Table 3). At the same time, I can get the confirmation points (see Table 4) which are generated from the last two steps, and also lead to get the precise trading points in the following step. Then, we

search the trading points among these confirmation points by satisfying the regulations of trading rule which have explained before. However, there is a key point needs to be clear when we make decision to buy or sell, which is because of all the data I have got so far are generated in each three days period, thus if I am going to find the exactly trading points (see Figure 6, buy at red points and sell at blue points) in the stock market I have to turn back to the original data with the data in daily type, locate the results from three days in the daily data, and find the corresponding trading prices (close price). This process is exampled in Figure 7.

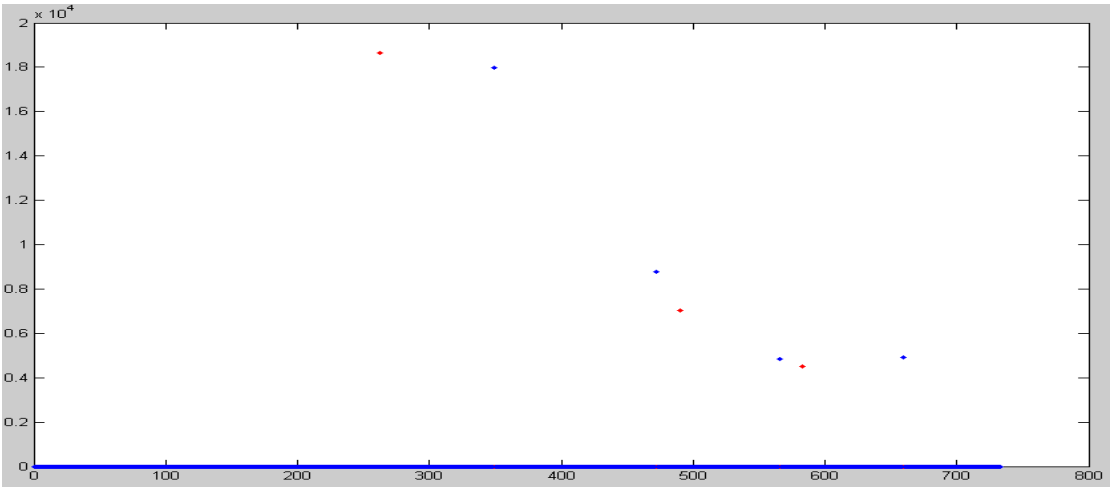


Figure 6 (from company Aggreko)

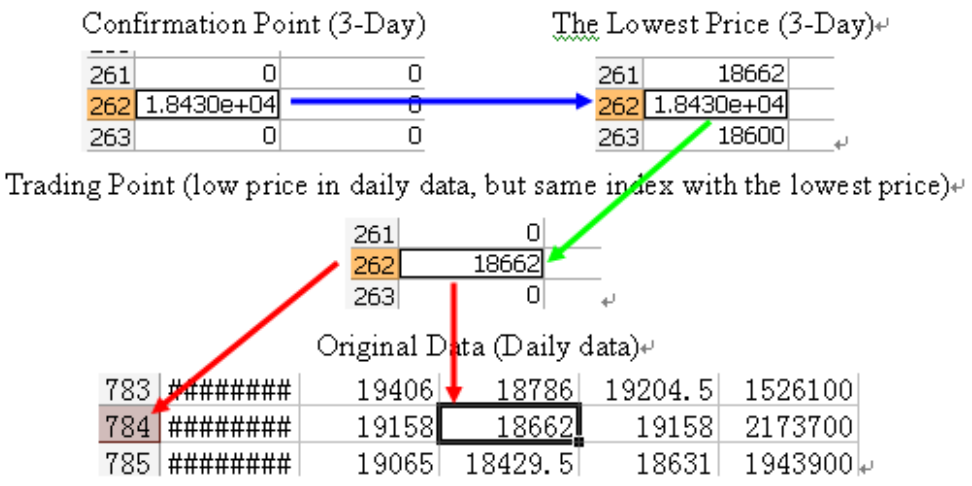


Figure 7 (from company Aggreko)

### 2.3. Returns of Rule 1

In the process of calculating the trading returns, suppose both buy and sell trading volume is 1000 at each trading time, which is unreality but easy to calculate and keep unified. Then, calculate each trading profit of the 40 stocks from FTSE 100 stock index by Rule 1.

Table 5 (returns of Rule 1)

| Name of the Stock | Returns |
|---|---|
| Aggreko PLC | 6308500 |
| Alliance Trust PLC | -2822450 |
| Antofagasta PLC | 1353900 |
| Associated British Food | -808500 |
| Astrazeneca PLC | 5843680 |
| Autonomy Corp PLC | -1646250 |
| Aviva PLC | -1755250 |
| Barclays PLC | 313750 |
| British American Tobacco | -2956000 |
| BG Group PLC | -661500 |
| BHP Billiton PLC | 2331500 |
| BP PLC | 109050 |
| BT Group PLC | 528250 |
| Burberry Group PLC | -148750 |
| Capital Shopping Centers Group PLC | 462500 |
| Compass Group PLC | -632750 |
| Diageo PLC | -1970500 |
| GKN PLC | -412750 |
| Glaxosmithkline PLC | -41500 |
| IMI PLC | -537750 |
| International Power PLC | -373750 |
| Intertek Group PLC | 139000 |
| Invensys PLC | -282350 |
| Land Securities Group PLC | -464500 |
| Legal & General Group PLC | 41550 |
| Next PLC | 1536000 |
| Prudential PLC | -49250 |
| Reed Elsevier PLC | 69850 |
| Rexam PLC | -303800 |
| SAB Miller PLC | 843500 |

| | |
|---|---|
| Admiral Group PLC | 70165000 |
| Bunzl PLC | 43793750 |
| Cairn Energy PLC | 146152510 |
| Carnival PLC | 206069000 |
| Centrica PLC | 23252400 |
| Eurasian Natural Resources Corporation | 35441250 |
| Experian PLC | 30897000 |
| G4S PLC | 16063450 |
| Icap Plc | 38599100 |
| RSA Insurance Group PLC | -349200 |

# 3. Technical Analyses

## 3.1. Evaluation of Rule 1 with Confusion Matrix

Confusion matrix is a tool usually being used in machine learning field. Generally, there are two classifications in confusion matrix, one is reality instance showed in rows and the other is prediction instance in columns.

Table 6 explains how confusion matrix works. TN is true negative which means a case is negative both in prediction and reality. TP refers to true positive that a case is positive both in prediction and reality. FP is short for false positive if the case is positive in prediction but negative in reality, and opposite is FN by meaning false negative. In addition, the number of all the negative cases in reality is R- and in prediction is P-, and the number of positive cases in reality and prediction are R+ and P+ separately. (Tsang, Markose & Er, 2005, p 440)

Table 6 (Confusion Matrix)

| | | Prediction | | |
|---|---|---|---|---|
| Reality | | - | + | |
| | - | TN | FP | R- |
| | + | FN | TP | R+ |
| | | P- | P+ | N |

Similarity, in my study the performance of Rule 1 can be evaluated with the return of each stock which I have got above from Matlab. In the fundamental tables (Table 7 and Table 8), on one hand, the value of reality class is classified into positive or negative which depends on the returns I have got are positive or negative. For instance, the return of Aggreko is 6308500 (positive), and then the classification of reality instance is positive. On the other hand, assume there are two situations about the prediction, one is all the predicted cases are true, the other is all the predictions are false. In the latter case, if all the predictions are false, the trading regulations of Rule 1 should be against the ones in former case. In other words, the instances in reality are running opposite way, such as in long entry the buy order happens when the market price closes above the sell stop (which was buy stop in former case), and in short entry the sell order comes up when market closes above buy stop (which was sell stop in former case).

Table 7 (suppose 1 all the predictions are correct)

| | Name of the Stock | Reality | Prediction |
|---|---|---|---|
| 1 | Aggreko PLC | + | + |
| 2 | Alliance Trust PLC | - | + |
| 3 | Antofagasta PLC | + | + |

| | | | |
|---|---|---|---|
| 4 | Associated British Food | - | + |
| 5 | Astrazeneca PLC | + | + |
| 6 | Autonomy Corp PLC | - | + |
| 7 | Aviva PLC | - | + |
| 8 | Barclays PLC | + | + |
| 9 | British American Tobacco | - | + |
| 10 | BG Group PLC | - | + |
| 11 | BHP Billiton PLC | + | + |
| 12 | BP PLC | + | + |
| 13 | BT Group PLC | + | + |
| 14 | Burberry Group PLC | - | + |
| 15 | Capital Shopping Centers Group PLC | + | + |
| 16 | Compass Group PLC | - | + |
| 17 | Diageo PLC | - | + |
| 18 | GKN PLC | - | + |
| 19 | Glaxosmithkline PLC | - | + |
| 20 | IMI PLC | - | + |
| 21 | International Power PLC | - | + |
| 22 | Intertek Group PLC | + | + |
| 23 | Invensys PLC | - | + |
| 24 | Land Securities Group PLC | - | + |
| 25 | Legal & General Group PLC | + | + |
| 26 | Next PLC | + | + |
| 27 | Prudential PLC | - | + |
| 28 | Reed Elsevier PLC | + | + |
| 29 | Rexam PLC | - | + |
| 30 | SAB Miller PLC | + | + |
| 31 | Admiral Group PLC | + | + |
| 32 | Bunzl PLC | + | + |
| 33 | Cairn Energy PLC | + | + |
| 34 | Carnival PLC | + | + |
| 35 | Centrica PLC | + | + |
| 36 | Eurasian Natural Resources Corporation | + | + |
| 37 | Experian PLC | + | + |
| 38 | G4S PLC | + | + |
| 39 | Icap Plc | + | + |
| 40 | RSA Insurance Group PLC | - | + |

Table 8 (suppose 2 that all the predictions are false)

| | Name of the Stock | Reality | Prediction |
|---|---|---|---|
| 1 | Aggreko PLC | + | - |
| 2 | Alliance Trust PLC | - | - |
| 3 | Antofagasta PLC | + | - |

| | | | |
|---|---|---|---|
| 4 | Associated British Food | + | - |
| 5 | Astrazeneca PLC | + | - |
| 6 | Autonomy Corp PLC | - | - |
| 7 | Aviva PLC | + | - |
| 8 | Barclays PLC | - | - |
| 9 | British American Tobacoon | - | - |
| 10 | BG Group PLC | - | - |
| 11 | BHP Billiton PLC | - | - |
| 12 | BP PLC | + | - |
| 13 | BT Group PLC | - | - |
| 14 | Burberry Group PLC | - | - |
| 15 | Capital Shopping Centers Group PLC | + | - |
| 16 | Compass Group PLC | - | - |
| 17 | Diageo PLC | - | - |
| 18 | GKN PLC | + | - |
| 19 | Glaxosmithkline PLC | - | - |
| 20 | IMI PLC | - | - |
| 21 | International Power PLC | + | - |
| 22 | Intertek Group PLC | + | - |
| 23 | Invensys PLC | + | - |
| 24 | Land Securities Group PLC | + | - |
| 25 | Legal & General Group PLC | + | - |
| 26 | Next PLC | + | - |
| 27 | Prudential PLC | + | - |
| 28 | Reed Elsevier PLC | + | - |
| 29 | Rexam PLC | + | - |
| 30 | SAB Miller PLC | + | - |
| 31 | Admiral Group PLC | + | - |
| 32 | Bunzl PLC | + | - |
| 33 | Cairn Energy PLC | + | - |
| 34 | Carnival PLC | + | - |
| 35 | Centrica PLC | + | - |
| 36 | Eurasian Natural Resources Corporation | + | - |
| 37 | Experian PLC | + | - |
| 38 | G4S PLC | + | - |
| 39 | Icap Plc | + | - |
| 40 | RSA Insurance Group PLC | + | - |

Then, confusion matrix of Rule 1 can be generated based on the data in two tables above.

Table 9 (Confusion Matrix of Rule 1)

| | | Prediction | | |
|---|---|---|---|---|
| Reality | | - | + | |
| | - | 12 | 18 | 30 |
| | + | 28 | 22 | 50 |
| | | 40 | 40 | 80 |

In confusion matrix, there are three main rates to be considered when we evaluate the efficiency of the prediction, which are correctness (or accuracy), the rate of missing chances (RMC) and the rate of failure (RF). Correctness is the rate of correct prediction, the rate missing chances is the proportion of positive cases in reality classified as negative, and the rate of failure evaluates the percentage of positive cases in prediction classified as false. We have to notice that the rate of failure is an essential measure because false negative is the real factor of loss, in other words, the number of cases are false negative determine the efficiency of the trading rule. Furthermore, there other two measures need to mention which are precision equals to 1-RF and recall measured by 1-RMC. (Edward, Sheri and Hakan, 2005, p 440)

Correctness= correct classifications/ total number of instance

= TN+TP/ N

RF= false positive/ number of positive instance in prediction

= FP/ P+

RMC= false negative/ number of true instance in reality

= FN/ R+

In my study, the result of correctness is 42.5% ((12+22)/80), RF equals to 45% (18/(18+22)), RMC is 70% (28/(18+22)), precision is 55% and recall is equal to 30%.

However, the performance of these results is not evaluated by individual numbers. It depends on the different investment situation and application. The correctness is below 50% which means the efficiency of this trading rule on prediction or making invest decision is not very well. In other words, less than 50% of decisions on buying and selling are wrong. While, the precision is 55% which is higher than recall (30%), and this presents that this trading plan at least can supply a good performance on getting trading chances, because once the false cases are classified wrong to true, it must has an impact on the return we expect at the beginning. In addition, there is another number we should pay attention which is false negative. In this result, false negative is relative higher than other three returns, which means more invest decisions are classified wrong and lead to losing money. (Edward, 2008, pp. 6-7)

### 3.2. Other Factors

Since the above analysis and evaluation of Rule 1, the result is not as ideal as we expected at the beginning. Stock market is much more changeable and unpredictable than we image, there are still plenty of factors have to be considered and analyzed such as price changing chart patterns, trading volumes and stock volatility.

### 3.2.1. Patterns

The pattern of stock prices content much information of the stock price movements. It exhibits the signals of investing and the change price tendency. It is a useful tool to provide information about current price change and predict the trend in future. Generally, there is an assumption that patterns are repeated in a stock, and such patterns supply a signal of certain trend or change. According to this function of patterns, traders can make their decision to buy and sell. In the area of technical analysis, stock patterns can be divided into two sorts, which are reversal and continuation. As a reversal pattern, all the signals from the last pattern will be reversed in the next one. But, the signals of a continuation pattern will keep moving on in the following pattern. (Cory, Chad and Casey, 2011)

Based on my study, I only concentrate on four kinds of pattern, such as head and shoulders, symmetrical triangle, flag and pennant and rectangle. Head and shoulders pattern is a very common pattern in stock market in a reversal formation. Such pattern (see Figure 8) includes three obvious peaks, which are the highest one in the middle named head and two relative lows peaks on the left and right side of head named shoulders. In the two gaps among these three peaks, there are two low valleys and can generate a line named neckline or support. As a head and should pattern, first of all, the last trend must be an uptrend (pink line), otherwise the reverse in this pattern can not exist. Second, during this previous upward, the left shoulder supplies the first peak

of this pattern which is also the highest point in the trend. The drop behind the first peak sets up the shape of left shoulder, which still belongs to the uptrend and the point 1 should above the trend line. The second peak named head in this pattern comes up after the left shoulder, and is higher than the first peak. A decline follows the head and leads the other low point 2, and also the point 2 always passes the uptrend. Then, the right shoulder represents another peak of the whole pattern, which is lower than the head but usually should in the same level with the left shoulder. The completion of this chart will goes down and crosses the neckline. The neckline is generated by the two low points, that point 1 finishes the left shoulder and starts the head, and point 2 ends the head and is the start of the right shoulder. Actually, the neckline can not only be horizontal but also be slope up or down, and it depends on the location of the two low points. The point when price breaks the neckline is the signal of the end of this chat pattern. (Robert D. E and John, 1948)

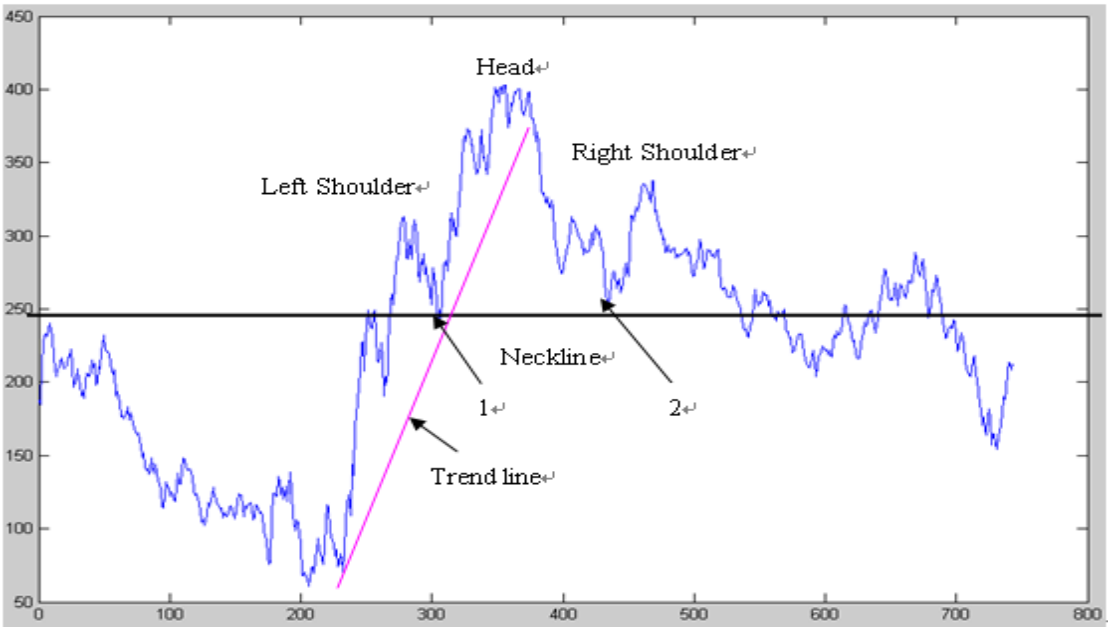


Figure 8 (from GKN PLC)

Different with the head and shoulders chart, the symmetrical triangle comes up in a continuation trend. Usually, it includes three high points and three low points which are appeared one by one, and these points shape the symmetrical triangle pattern. As Figure 9 shows that to build up this pattern takes several month, and the trend in this long term has shaped already. This trend is also the fundament of forming a continued trend. Among the three high points, the second high (point 4) has to be lower than point 1, and then the slope of highs goes down. Similarly, the second low should be higher than the first one and the slope is up. According to these highs and lows, the symmetrical triangle can be made before the break. Sometimes, the direction of future tendency can be predicted once the break comes up. But, this attempting takes risk in prediction even this pattern is a long term trend. (Robert D. E and John, 1948)

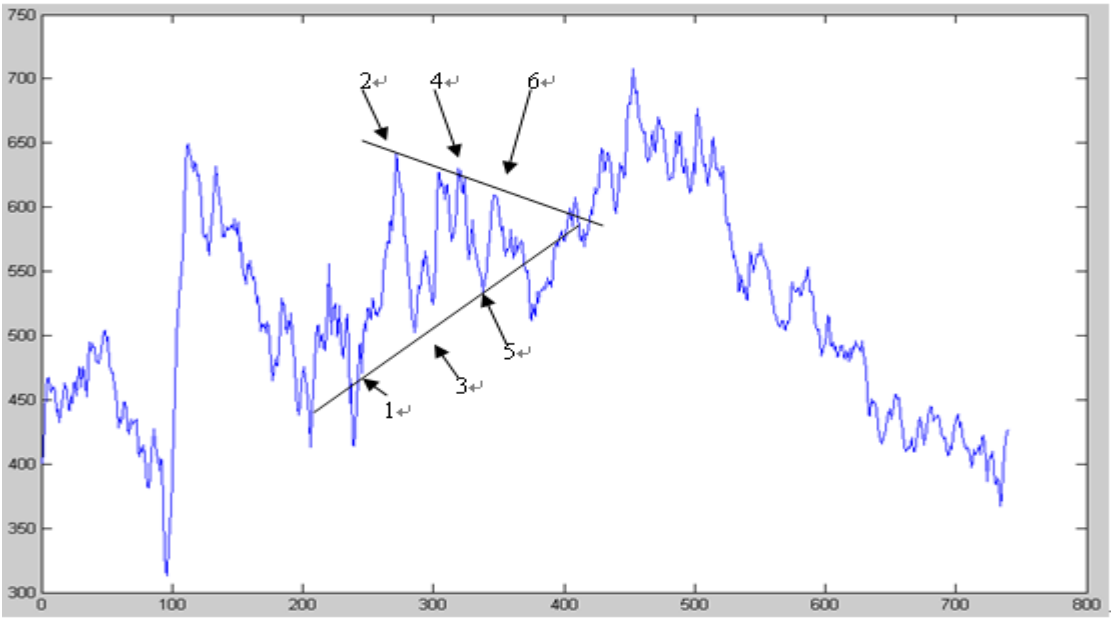


Figure 9 (from BP PLC)

Flag and pennant pattern is a continuation form but in a short term. This kind of pattern continues with a sudden increase or drop with a large amount of volume.

There are two shapes in this chart, flag and pennant, but this study only focus on flag chart. (See figure 10) In fact, the flag pattern is a small size of rectangle which is shaped with two parallels. The slope of the two parallels is against the prior trend, which means if the prior trend is up the slope of flag is down, and the slope will go up if the trend is down. There is no exactly highs or lows in this chart pattern, because flag just takes a short term process that we only need to take the price movements between the two parallels into account. In a bear market or a downward, this pattern is broke with a following down trend, at the same time prices go down below the under parallel. (Robert D. E and John, 1948)

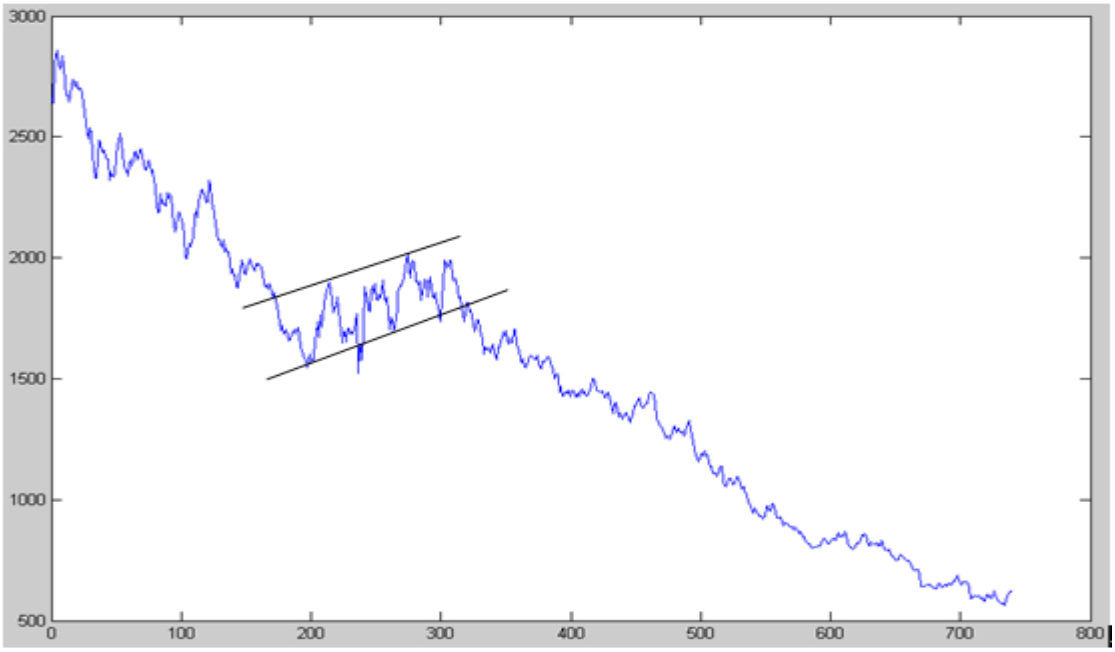


Figure 10 (from company British American Tobacco PLC)

The last popular form of pattern is rectangle appears (see Figure 11 and 12) both in down and up trend, which is a continuation pattern. To make up this pattern, at least two highs are required to link to form the resistance line and two lows to generate support line. It will be perfect if all the high points or low points are equal, but usually

they can have a small range of price movement or margin among each other. In addition, the highs and lows do not have to occur in a specific order in the rectangle. The period provided in this chart pattern is relatively regular to the traders, which means it is easy to follow the price movements during this pattern period. Similar with symmetrical triangle, rectangle can point the highs and lows in the pattern as well. However, the difference with symmetrical triangle is the pattern of rectangle will not finish until the price line breaks either resistance or support line, so that it is hard to find the direction of price change at the start of this pattern. It is only can find the direction of the future trend when the resistance or support line is broke. (Robert D. E and John, 1948)

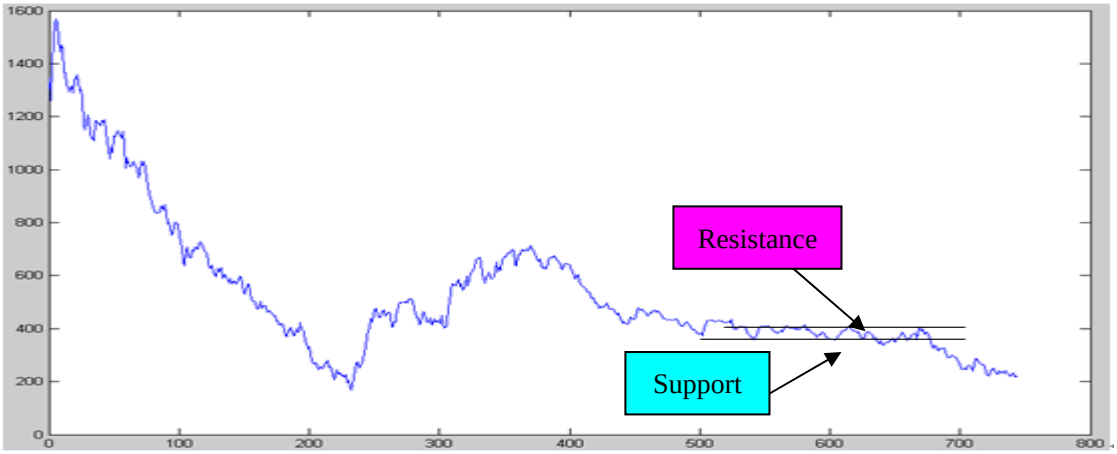


Figure 11 downtrend (from Burberry Group PLC)

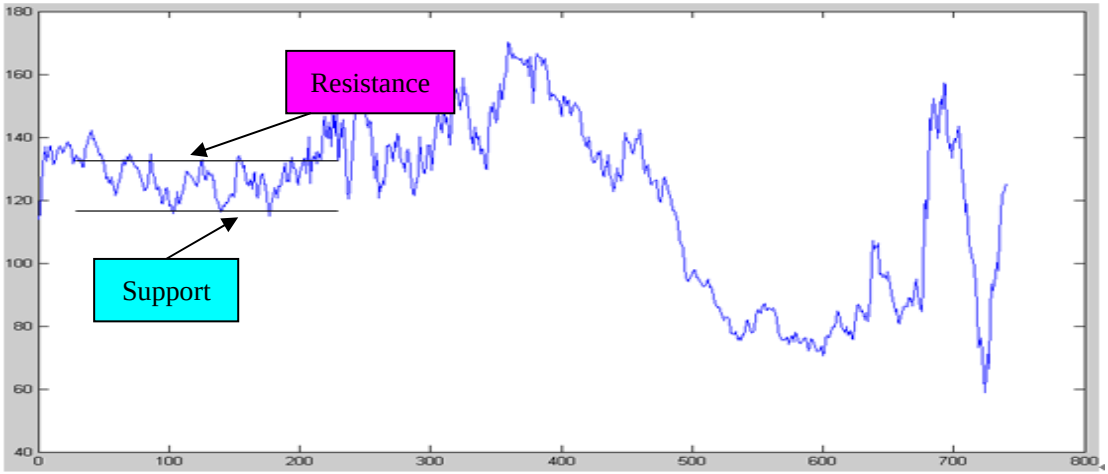

Figure 12 uptrend (from company RSA Insurance Group)

### 3.2.2. Volume

While, the second essential factor of technical analysis in stock market is trading volume, which plays an important role of affecting both price patterns and market tendency. It is defined as a number of individual stocks being traded in a certain time interval which is three days in my study. Usually, trading volume shows the level of activeness of the stock in price movement, in other words, the higher volume corresponds to much more activated stock. On one hand, the stock volumes exhibit the price tendency, if the stock price is in an uptrend the corresponding volumes should rise up, but if the price declines the volumes go down as well. However, the relation between trading volume and price trend is always told by an opposite story. There is a divergence between volume and price, which means when the price is rise up to a peak the volume is in the downtrend to a valley, and vice versa. In addition, if the market starts with a relative weakness in trading volume and price changing, it is a signal of a negative trend. On the other hand, volume can be used as a confirmation of different types of chart patterns, such as head and shoulders, symmetrical triangle, flag and rectangle which I mentioned in above. In each pattern, there must be some key points which content useful information about stock market tendency to show the analysts, and these key points are also can be found in the corresponding volume. Nevertheless, if the fully informational points are hard to confirm in the trading volume, that means the signs from the pattern are not strong enough. (Cory, Chad and Casey, 2011)

### 3.2.3. Volatility

In stock market analysis, another factor is volatility which can be used as an indication because of it is sensitive to the market changes and represents much information. Usually, stock volatility is calculated by standard derivation, which is able to show the probability of extreme values among the returns. High standard derivation exhibits the high probability of getting both extreme positive and negative values. The reasons of why volatility is much essential in stock market technical analysis are explained following. First, once the new information spread out, there must be a big influence of traders' action. Then, the so fast speed of information spreading relates to the rate of price movements directly. At the same time, the liquidity of mature stock market has a close relation with the price of stock, which means the liquidity increases when the stock market in an uptrend and decreases if the market in a down tendency. (G. William, 1990)

Generally, stock volatility plays an important role in market performance, in other words, there is a big interaction between volatility and stock tendency. It relates not only market returns but also invest risk. If the stock market attempt to go up, volatility will decreases. At the same time, if volatility tries to increase, the tendency of stock market should have a downtrend. Moreover, risk changes followed the change of volatility roughly, but stock returns towards the opposite way which means when volatility increases the returns go down. This is due to that risk is defined as the

dispersion of returns around mean, and the larger dispersion the bigger decline of returns. (Cory, Chad and Casey, 2011)

From the above understanding of chat patterns, trading volumes and stock volatility, there are two main relationships of them, which are volume is the indicator of stock tendency and pattern styles and volatility relates to the market returns. However, in my study, I only concentrate on the relationship between patterns and volumes.

First, the head and shoulders chart of company GKN is in a slightly upward trend and this pattern supply a high point at head. While, this kind of pattern can be easily found in the price figure, it is not so obvious in volume figure. For trading volumes (see Figure 13), they are usually showed in an opposite trend as the stock prices, in other words, volumes get low when prices are high and volumes go up when prices go down. There is a short covering action (get out all the shorts instead of get new longs) during the period of head completion. Moreover, a horizontal line of the volumes exhibits the break through neckline. (Kevin M., 2011)

It is essential to notice that head and shoulders pattern happens after an uptrend, and complete a main reversal during the pattern period. If the price breaks the neckline which is a support in the chart, there will be an action to sell at lower prices. However, lower prices are generated by the combination of an increasing volume and a corresponding increasing order. (Robert D. E and John, 1948)

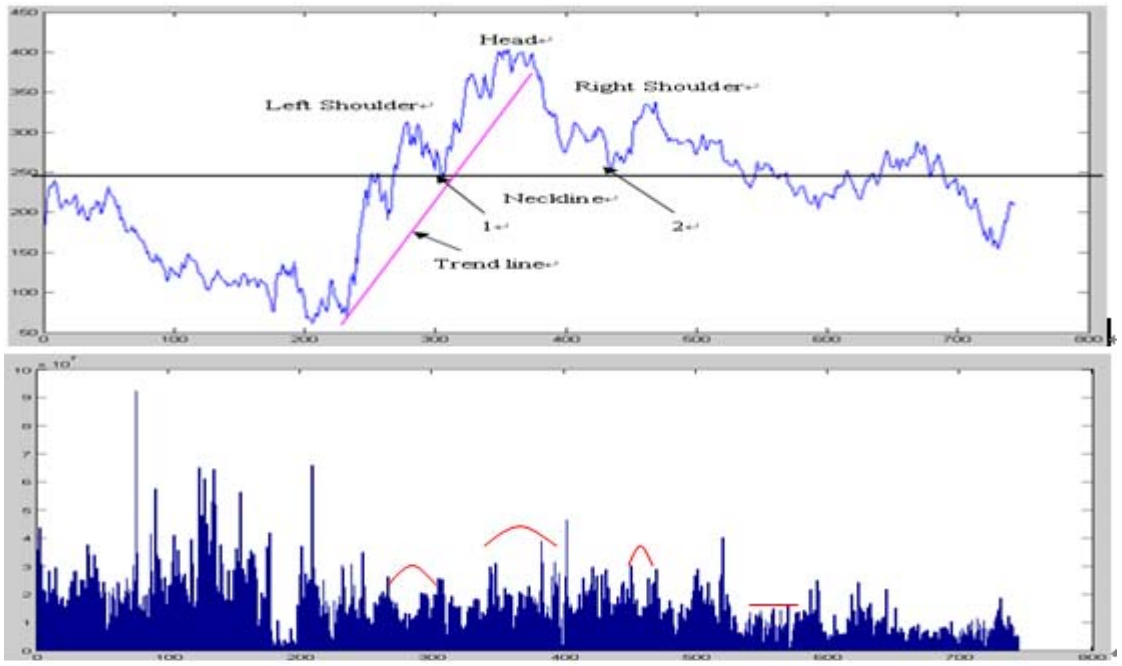


Figure 13 (Volume of company GKN PLC)

(Note: There are two relative high volumes in the data of GKN and they are not related to the period of the chart, so I divided $1*10^2$ artificially in order to analyze the pattern in main period more easily.)

Second, BP is one of the companies with a symmetrical triangle pattern of its price movements (see Figure 14). It can be a good signal to traders that symmetrical occurs at the start of an upward trend (Kevin M., 2011). Because, during the period of alternation between highs and lows there is a relative stable trading volume in return which represents not too much action on trading. But, if the following down break happens with an uptrend, it is an uptrend reacted in volume chart, which shows an increase in long. Similar with the head and shoulders pattern, in the whole process of pattern formation, the relation between price changes and trading volumes is opposite, in other words, volumes are low when the prices go up, and vice versa.

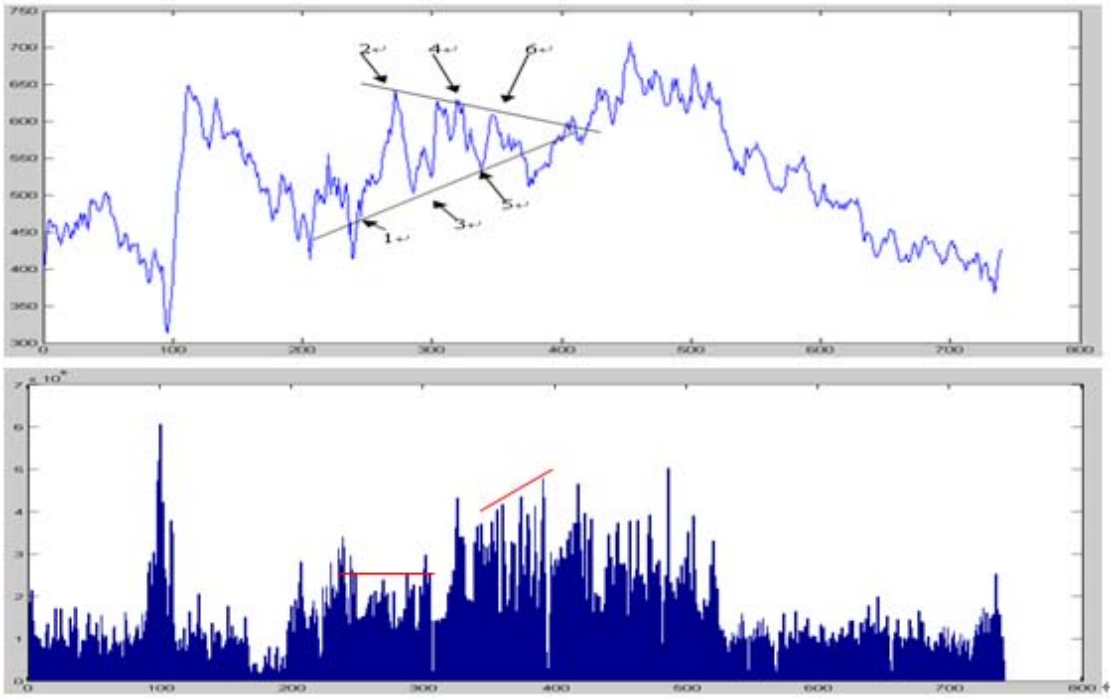


Figure 14 (Volume of company BP PLC)

(Note: There is a relative high volume in the data of BP and it is not related to the period of the chart, so I divided $1*10^2$ artificially in order to analyze the pattern in main period more easily.)

The third chart is from company British American Tobacco with a bear flag pattern in a downtrend (see Figure 15). There is a flag pattern in price chart with an upward slope, and this corresponds to chart volume with a period of stability but still goes down (the two red horizontal lines in volume chart) due to the up slope in price chart. At the break point, the volumes rise up during the down break of support. However, after this increase, the price pattern turns back to the same trend (down) as before. (Kevin M., 2011) In addition, price movements and trading volumes still in the same relation as the last two patterns.

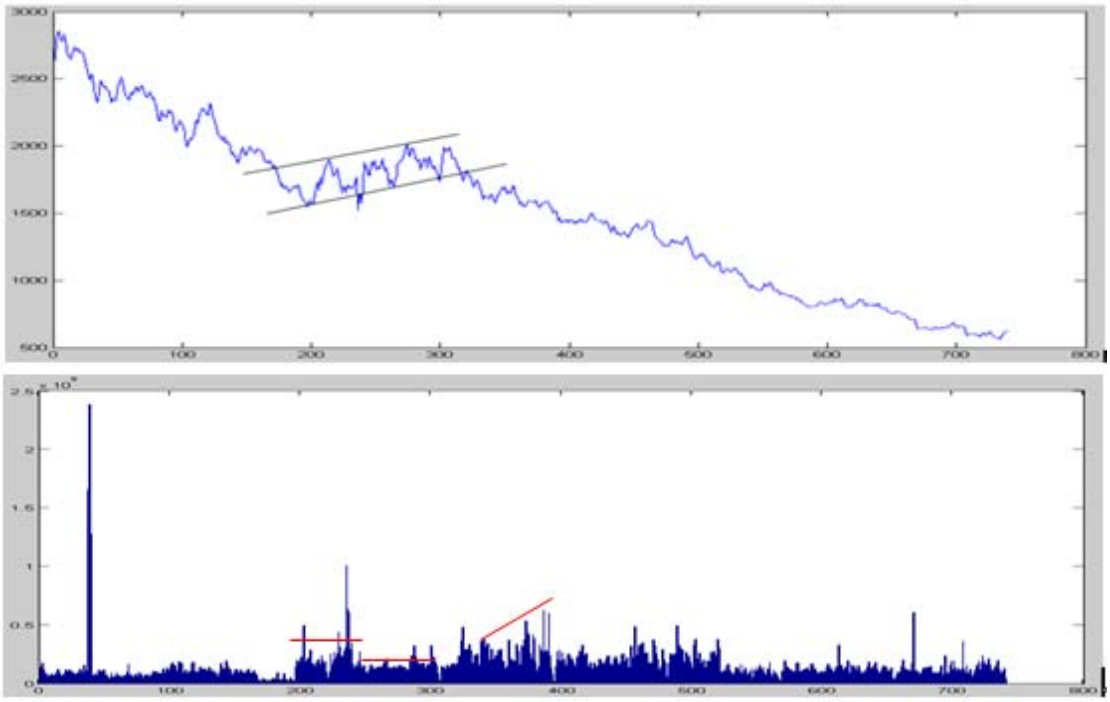

Figure 15 (Volume of company British American Tobacco)

(Note: There is a relative high volume in the data of British American Tobacco and it is not related to the period of the chart, so I divided $1*10^2$ artificially in order to analyze the pattern in main period more easily.)

The last pattern is rectangle both in downward and upward trend. As we can see in Figure 16 the rectangle appears after a big drop and keeps for a long-term period. In some extent, this rectangle provides a relative consolidation period to not only stock prices but also trading volume, in order to figure out the direction in the future. The market chooses to go down by breaking the support and leads an increase in volume chart. The same as downtrend (see Figure 17), rectangle in uptrend also gets a balance from the formation of rectangle, and a rise in volume when the price breaks the resistance. (Kevin M., 2011) There is a common signal that the break point in both up and down trend supplies the increase of trading volume. Furthermore, the relation of prices and volumes in this chart pattern is still the same as the above types of pattern.

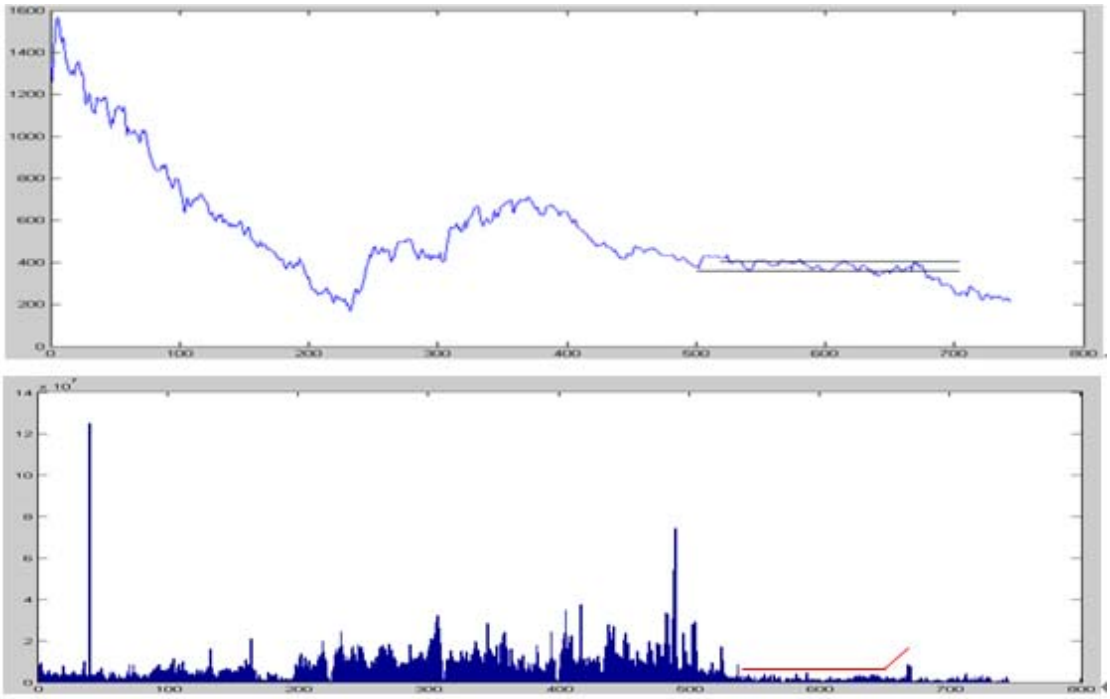

Figure 16 downtrend (from Burberry Group PLC)

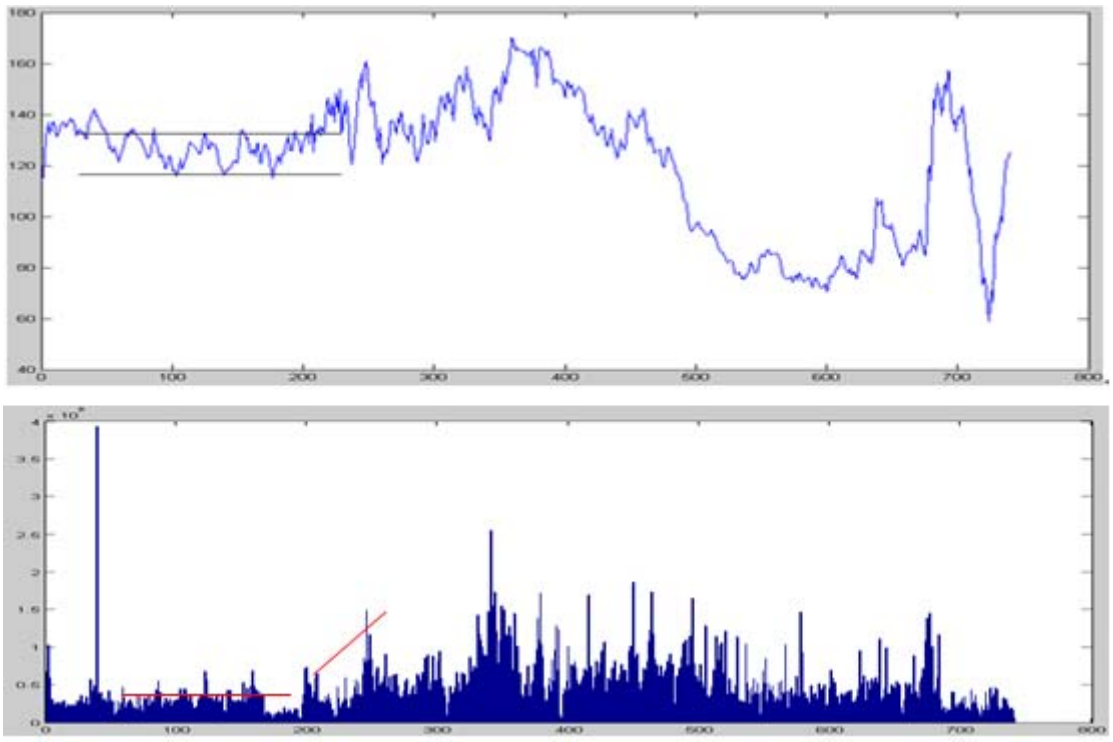

Figure 17 uptrend (from company RSA Insurance Group)

(Note: There is a relative high volume in the data of RSA Insurance Group and it is not related to the period of the chart, so I divided $1*10^2$ artificially in order to analyze the pattern in main period more easily.)

### 3.3. New Trading Rule—Rule 2

According to the technical analysis above from several aspects, I would like to improve the Rule 1 by taking the trading volume into account during the process of making invest decisions. From the analysis, we can notice that the relation between price movements and trading volumes is opposite, which is satisfied in all types of chart patterns I analyze. Thus, I tend to put one more limitation in the trading rule about volume and generated Rule 2. Moreover, combining the chart patterns with data, I figure out that the average volume in every three days is increase when the price in a downward trend, while it declines in an upward trend of price.

Rule 1 in Long Entry (see Figure 4) (Robert- MH-BCHE, 2005, p 30):

(1). There must be an upward trend appears in the time series.

(2). Directional change helps us to report the valleys as last low prices in the whole period.

(3). From each last low point, we go forward by two ticks and stop at bar A, and then compare the three market close prices with the value of buy stop on Hilo Activator bar A. If one of the three close prices is higher than the buy stop, we make trading decision to buy at that close price, and report the corresponding last low point as one confirmation point. Otherwise, go to next last low point and repeat the whole process.

Rule 2 in Long Entry:

(1). There must be an upward trend appears in the time series.

(2). Directional change helps us to report the valleys as last low prices in the whole period.

(3). From each last low point, we go forward by two ticks and stop at bar A, and then compare the three market close prices with the value of buy stop on Hilo Activator bar A. At the same time, there is one more limitation than Rule 1, if not only one of the three close prices is higher than the buy stop, but also the trading volume is in a downtrend, and then we make trading decision to buy at that close price, and report the corresponding last low point as one confirmation point. Otherwise, go to next last low point and repeat the whole process.

Rule 2 in Short Entry:

(1). There must be a downtrend appears in the time series.

(2). Directional change helps us to report the peaks as last high prices in the whole period.

(3). From each last high point, we go forward by two ticks and stop at bar A, and then compare the three market close prices with the value of sell stop on Hilo Activator bar A. At the same time, there is one more limitation than Rule 1, if not only one of the three close prices is lower than the sell stop, but also the trading volume is in an uptrend, and then we make trading decision to sell at that close price, and report the corresponding last high point as one confirmation point. Otherwise, go to next last high point and repeat the whole process.

Table 10 Comparison between Rule 1 & Rule 2

| | Rule 1 | | Rule 2 | |
|---|---|---|---|---|
| | Long Entry | Short Entry | Long Entry | Short Entry |
| 1 Trend | uptrend | downtrend | uptrend | downtrend |
| 2 Directional Change | lows | highs | lows | highs |
| 3 Limitations of Trading decision | (1) after two ticks; (2) close price > buy stop | (1) after two ticks; (2) close price > buy stop | (1) after two ticks; (2) close price > buy stop; (3) volume in downtrend | (1) after two ticks; (2) close price > buy stop; (3) volume in uptrend |

Then, I get the new results from Rule 2 in Table 11 (the returns from Rule 1 named Return 1 and Return 2 are from Rule 2).

Table 11

| Name of the Stock | Return 1 | Return 2 | R2-R1 |
|---|---|---|---|
| Aggreko PLC | 6308500 | -2.4E+07 | - |
| Alliance Trust PLC | -2822450 | 5362050 | + |
| Antofagasta PLC | 1353900 | 1784400 | + |
| Associated British Food | -808500 | 678000 | + |
| Astrazeneca PLC | 5843680 | 5506000 | - |
| Autonomy Corp PLC | -1646250 | 653750 | + |
| Aviva PLC | -1755250 | -975000 | + |
| Barclays PLC | 313750 | 1119750 | + |
| BAT | -2956000 | 947000 | + |
| BG Group PLC | -661500 | -1013500 | - |
| BHP Billiton PLC | 2331500 | -43000 | - |
| BP PLC | 109050 | 142850 | + |
| BT Group PLC | 528250 | 512250 | - |
| Burberry Group PLC | -148750 | 1402500 | + |
| Capital Shopping Centers Group PLC | 462500 | -837250 | - |
| Compass Group PLC | -632750 | -107250 | + |

| | | | |
|---|---|---|---|
| Diageo PLC | -1970500 | -1080500 | + |
| GKN PLC | -412750 | -125750 | + |
| Glaxosmithkline PLC | -41500 | -235500 | - |
| IMI PLC | -537750 | 1764750 | + |
| International Power PLC | -373750 | -732500 | - |
| Intertek Group PLC | 139000 | -1425000 | - |
| Invensys PLC | -282350 | 493250 | + |
| Land Securities Group PLC | -464500 | 3043000 | + |
| Legal & General Group PLC | 41550 | -30750 | - |
| Next PLC | 1536000 | -1481000 | - |
| Prudential PLC | -49250 | 0 | + |
| Reed Elsevier PLC | 69850 | -1203440 | - |
| Rexam PLC | -303800 | 552000 | + |
| SAB Miller PLC | 843500 | -171100 | - |
| Admiral Group PLC | 70165000 | 283500 | - |
| Bunzl PLC | 43793750 | 37923000 | - |
| Cairn Energy PLC | 146152510 | 23301000 | - |
| Carnival PLC | 206069000 | 83431050 | - |
| Centrica PLC | 23252400 | 105140500 | - |
| Eurasian Natural Resources Corporation | 35441250 | 12250750 | - |
| Experian PLC | 30897000 | 18019750 | - |
| G4S PLC | 16063450 | 16796500 | - |
| Icap Plc | 38599100 | 9797300 | - |
| RSA Insurance Group PLC | -349200 | 19429250 | + |

Firstly, from the view of profit, we can see in Table 11 that once Rule 2 considers the technical analysis factor trading volumes, most of the return of each stock has a rise, even some of the margins between the original returns and improved ones are negative, but the returns are still positive beside earn less. At least, this is good news which proves the improvement is helpful to make trading decision.

To assess the efficiency of Rule 2, I still prefer using confusion matrix so that the results can easily be compared with Rule 1. But, the difference is in the opposite matrix not only changing the conditions of buy stop and sell stop as before, but also

the trading volume limitation needs to run in the opposite way as well, which means when prices with an uptrend volumes have to be in an uptrend and when prices go down volumes decline.

Table 12 (suppose 1 all the predictions are correct)

| | Name of the Stock | Reality | Prediction |
|---|---|---|---|
| 1 | Aggreko PLC | - | + |
| 2 | Alliance Trust PLC | + | + |
| 3 | Antofagasta PLC | + | + |
| 4 | Associated British Food | + | + |
| 5 | Astrazeneca PLC | + | + |
| 6 | Autonomy Corp PLC | + | + |
| 7 | Aviva PLC | - | + |
| 8 | Barclays PLC | + | + |
| 9 | British American Tobacco | + | + |
| 10 | BG Group PLC | - | + |
| 11 | BHP Billiton PLC | - | + |
| 12 | BP PLC | + | + |
| 13 | BT Group PLC | + | + |
| 14 | Burberry Group PLC | + | + |
| 15 | Capital Shopping Centers Group PLC | - | + |
| 16 | Compass Group PLC | - | + |
| 17 | Diageo PLC | - | + |
| 18 | GKN PLC | - | + |
| 19 | Glaxosmithkline PLC | - | + |
| 20 | IMI PLC | + | + |
| 21 | International Power PLC | - | + |
| 22 | Intertek Group PLC | - | + |
| 23 | Invensys PLC | + | + |
| 24 | Land Securities Group PLC | + | + |
| 25 | Legal & General Group PLC | - | + |
| 26 | Next PLC | - | + |
| 27 | Prudential PLC | + | + |
| 28 | Reed Elsevier PLC | - | + |
| 29 | Rexam PLC | + | + |
| 30 | SAB Miller PLC | + | + |
| 31 | Admiral Group PLC | + | + |
| 32 | Bunzl PLC | + | + |
| 33 | Cairn Energy PLC | + | + |
| 34 | Carnival PLC | + | + |

| | | | |
|---|---|---|---|
| 35 | Centrica PLC | + | + |
| 36 | Eurasian Natural Resources Corporation | + | + |
| 37 | Experian PLC | + | + |
| 38 | G4S PLC | + | + |
| 39 | Icap Plc | + | + |
| 40 | RSA Insurance Group PLC | - | + |

Table 13 (suppose 2 that all the predictions are false, and trade against the rule)

| | Name of the Stock | Reality | Prediction |
|---|---|---|---|
| 1 | Aggreko PLC | + | - |
| 2 | Alliance Trust PLC | - | - |
| 3 | Antofagasta PLC | - | - |
| 4 | Associated British Food | - | - |
| 5 | Astrazeneca PLC | + | - |
| 6 | Autonomy Corp PLC | - | - |
| 7 | Aviva PLC | + | - |
| 8 | Barclays PLC | + | - |
| 9 | British American Tobacoon | - | - |
| 10 | BG Group PLC | - | - |
| 11 | BHP Billiton PLC | - | - |
| 12 | BP PLC | + | - |
| 13 | BT Group PLC | - | - |
| 14 | Burberry Group PLC | - | - |
| 15 | Capital Shopping Centers Group PLC | + | - |
| 16 | Compass Group PLC | - | - |
| 17 | Diageo PLC | + | - |
| 18 | GKN PLC | + | - |
| 19 | Glaxosmithkline PLC | - | - |
| 20 | IMI PLC | + | - |
| 21 | International Power PLC | + | - |
| 22 | Intertek Group PLC | + | - |
| 23 | Invensys PLC | + | - |
| 24 | Land Securities Group PLC | + | - |
| 25 | Legal & General Group PLC | + | - |
| 26 | Next PLC | - | - |
| 27 | Prudential PLC | + | - |
| 28 | Reed Elsevier PLC | - | - |
| 29 | Rexam PLC | + | - |
| 30 | SAB Miller PLC | + | - |
| 31 | Admiral Group PLC | + | - |
| 32 | Bunzl PLC | + | - |
| 33 | Cairn Energy PLC | + | - |
| 34 | Carnival PLC | + | - |

| | | | |
|---|---|---|---|
| 35 | Centrica PLC | + | - |
| 36 | Eurasian Natural Resources Corporation | + | - |
| 37 | Experian PLC | + | - |
| 38 | G4S PLC | + | - |
| 39 | Icap Plc | + | - |
| 40 | RSA Insurance Group PLC | - | - |

Then, the new confusion matrix of Rule 2 can be generated based on the data in two tables above.

Table 14 (Confusion Matrix of Rule 2)

| | | Prediction | | |
|---|---|---|---|---|
| Reality | | - | + | |
| | - | 14 | 15 | 29 |
| | + | 26 | 25 | 51 |
| | | 40 | 40 | 80 |

Thus, in this new confusion matrix we can get the new returns of the basic parameters. Correctness is 48.75% ((14+25)/80) (42.5% before), RF is equal to 37.5% (15/40) (45% before), RMC is 51.00% (26/51) (70% before), precision is 62.5% (55% before) and recall is equal to 49.00% (30% before). Although the correctness is still below 50%, there are a lot of reasons to support the a little disappointing answer, and also it is higher than the previous one which shows the improvement of this new trading rule. Precision is higher than before which represents the correctness of prediction of this trading rule is better than the original one. The most attractive return is recall with 19% increase, and this fully proves the trading rule which not only consider the price movements but also the changes of trading volume can have a good performance in

stock market.

## 4. Conclusions and Future Work

In this study, I picked one of Gann's trading rules as my original rule and run it with random 40 FTSE 100 companies' stock data in certain periods. In the first evaluation, I only considered the price changes and market directional changes which are based on Gann's trading rule (Rule 1). While, the testing results did not show a satisfied performance and efficiency of the trading rule. Then, from the further technical analysis of the other factors such as chart patterns, trading volumes and stock volatility, I figured out that there is a strong relation between price movements and trading volume changes in all the typical types of pattern that I analyzed. It is described as if the stock price is in a downtrend trading volume in the corresponding period should increase, and when price is in an uptrend volume declines. According to this phenomenon, I took trading volume into account as another limitation of Rule 2 to make more precise invest decisions. This term, I evaluated Rule 2 in two approaches, one is much direct way that calculates the returns from Rule 2 and also compares the two returns from Rule 1 and Rule 2 of each stock, and the other is still use confusion matrix to assess the efficiency of Rule 2 by the basic parameters. In conclusion, the improved Rule 2 with the volume factor has better performance in the stock market than the simple Rule 1, which can be proved not only from the pure returns but also the results from confusion matrix.

However, there is still one aspect that I have not referred too much in this study which is stock volatility. Definitely, it is another essential factor of stock market, which contents a large amount of information to help traders to analyze the movements in stock market and make trading decisions. Thus, I would like to do some further study in this area to build an optimal trading rule with good performance and high efficiency in the unpredictable stock market.

# Bibliography

Terence C. Mills, (1997). Technical Analysis and the London Stock Exchange: Testing Trading Rules Using the FT30. Int. J. Fin. Econ. 2, pp. 319-331.

Edwards, R. D., and J. Magee, (1967). Technical Analysis of Stock Trends (5th edn). Boston MA: John Magee.

Murphy, J.J., (1986). Technical Analysis of the Futures Markets. New York: New York Institute of Finance.

Brock W., Lakonishok J., LeBaron B., (1992). Simple Technical Trading Rules and the Stochastic Properties of Stock Returns. Journal of Finance, Volume 47, pp. 1731-1764.

Malkiel, B., (1981). A Random Walk Down Wall Street, 2 ed. (Norton, New York)

Robert Krausz, MH, BCHE, (2005). W.D. Gann Treasure Discovered Simple Trading Plans for Stocks & Commodities.

Anon., n.d.. FTSE 100 INDEX FACTSHEET. FTSE THE INDEX COMPANY, [online]. Available at: http://www.ftse.com/Indices/UK_Indices/Downloads/FTSE_100_Index_Factsheet.pdf [Accessed 6th August 2011].

Robert Krausz, MH, BCHE, n.d.. New Gann Swing Chartist ™ Dynamic Fibonacci Channels ™, Fibonacci Trader Journal Volume1 Issue2.

Edward, E.P.K., Markose, S. & Er, H., (2005). Chance Discovery in Stock Index Option and Futures Arbitrage. New Mathematics and Natural Computation, World Scientific, Vo.1, No.3, pp. 435-447

Edward Tsang, (2008), Forecasting-where computational intelligence meets the stock market. Working paper WP026-08, Centre for Computational Finance and Economic Agents, University of Essex.

Cory Janssen, Chad Langager and Casey Murphy, (2011). Technical Analysis: Introduction, INVESTOPEDIA, [online]. Available at: http://www.investopedia.com/university/technical/#axzz1WXZpN42S [Accessed 6th August 2011]

Robert D. Edwards and John Magee, (1948). Technical Analysis of Stock Trends, 8th edit. CRC Press.

G. William Schwert, 1990, Stock Market Volatility, Financial Analysis Journal, May-June 1990, pp. 23-34

Kevin Matras, (2011). Finding #1 Stocks: Screening, Backtesting and Time-Proven Strategies, John Wiley & Sons.

## Appendix

All the original data are from http://finance.yahoo.com/, and I pick the first 60 data of company Aggreko PLC as an example to show the structure of the data.

Table 1 (60 days data of company Aggreko PLC)

| Date | High | Low | Close | Volume |
|---|---|---|---|---|
| 2011-8-12 | 1879 | 1730 | 1879 | 1131600 |
| 2011-8-11 | 1768 | 1694 | 1768 | 1415200 |
| 2011-8-10 | 1780 | 1683 | 1696 | 1408100 |
| 2011-8-9 | 1710 | 1551 | 1700 | 2350000 |
| 2011-8-8 | 1729 | 1626 | 1628 | 1308800 |
| 2011-8-5 | 1753 | 1657 | 1707 | 1135700 |
| 2011-8-4 | 1850 | 1735 | 1739 | 861300 |
| 2011-8-3 | 1870 | 1796 | 1821 | 953700 |
| 2011-8-2 | 1909 | 1870 | 1892.69 | 784200 |
| 2011-8-1 | 1966 | 1902 | 1903 | 462500 |
| 2011-7-29 | 1944 | 1909 | 1933 | 434800 |
| 2011-7-28 | 1938 | 1911 | 1929.04 | 630700 |
| 2011-7-27 | 2001 | 1941 | 1943 | 719000 |
| 2011-7-26 | 2006.61 | 1972 | 1999.29 | 572700 |
| 2011-7-25 | 2003 | 1980 | 1996 | 883900 |
| 2011-7-22 | 2003 | 1982.82 | 1994 | 625100 |
| 2011-7-21 | 2007 | 1962 | 1987.25 | 2099800 |
| 2011-7-20 | 2020 | 1988 | 1992 | 1084900 |
| 2011-7-19 | 2013 | 1962 | 1985.7 | 2055600 |
| 2011-7-18 | 2031 | 1960 | 1969 | 1088500 |
| 2011-7-15 | 2044 | 1998 | 2021.97 | 1402800 |
| 2011-7-14 | 2051 | 2012 | 2034 | 1313000 |
| 2011-7-13 | 2033 | 1983 | 2031 | 1008600 |
| 2011-7-12 | 2005 | 2005 | 2005 | 0 |
| 2011-7-11 | 2047 | 1976.41 | 1991 | 788000 |
| 2011-7-8 | 62992 | 61937.88 | 62155 | 757800 |
| 2011-7-7 | 62496 | 61659 | 62310 | 549500 |
| 2011-7-6 | 61845 | 61101 | 61690 | 881600 |
| 2011-7-5 | 61928.64 | 61287 | 61752 | 502100 |
| 2011-7-4 | 61504 | 60295 | 61380 | 349200 |
| 2011-7-1 | 60295 | 59489 | 60264 | 563400 |
| 2011-6-30 | 59861 | 58156 | 59799 | 629300 |
| 2011-6-29 | 58559 | 57474 | 58373 | 514600 |
| 2011-6-28 | 57691 | 56792 | 57520.5 | 508600 |

| | | | | |
|---|---|---|---|---|
| 2011-6-27 | 56792 | 56017 | 56668 | 449500 |
| 2011-6-24 | 57350 | 56203 | 56327 | 819100 |
| 2011-6-23 | 57505 | 56327 | 56544 | 679300 |
| 2011-6-22 | 58435 | 57629 | 57722 | 877900 |
| 2011-6-21 | 58404 | 57753 | 58125 | 606100 |
| 2011-6-20 | 58931 | 56947 | 58094 | 859400 |
| 2011-6-17 | 59272 | 57536 | 59241 | 772200 |
| 2011-6-16 | 58528 | 56885 | 57846 | 1235900 |
| 2011-6-15 | 59210 | 58590 | 58807 | 818000 |
| 2011-6-14 | 59451.18 | 58249 | 59241 | 841500 |
| 2011-6-13 | 59675 | 57257 | 58094 | 1657300 |
| 2011-6-10 | 60729 | 59675 | 59985 | 648300 |
| 2011-6-9 | 60109 | 59055 | 59954 | 501000 |
| 2011-6-8 | 59675 | 58962 | 59179 | 658300 |
| 2011-6-7 | 59301.76 | 58807 | 59179 | 735200 |
| 2011-6-6 | 59179 | 57970 | 59024 | 425300 |
| 2011-6-3 | 58683 | 57815 | 58280 | 620700 |
| 2011-6-2 | 58683 | 57288 | 58063 | 820900 |
| 2011-6-1 | 58931 | 58001 | 58342 | 1203200 |
| 2011-5-31 | 58497 | 56637 | 57877 | 1408800 |
| 2011-5-27 | 56327 | 55490 | 56234 | 463600 |
| 2011-5-26 | 55924 | 54932 | 55211 | 856400 |
| 2011-5-25 | 55955 | 54188 | 55800 | 887300 |
| 2011-5-24 | 54932 | 53010 | 54839 | 573700 |
| 2011-5-23 | 53599 | 52979 | 53072 | 648600 |
| 2011-5-20 | 55583 | 53971 | 54343 | 703700 |

Table 2 (60 days sell stop, buy stop, highest price, lowest price and average close price of company Aggreko PLC gets from programming)

| Period | Sell Stop | Buy Stop | Highest Price | Lowest Price | Average Close |
|---|---|---|---|---|---|
| 1 | 1702.33333333333 | 1809 | 1879 | 1683 | 1781 |
| 2 | 1611.33333333333 | 1730.66666666667 | 1753 | 1551 | 1678.33333333333 |
| 3 | 1800.33333333333 | 1876.33333333333 | 1909 | 1735 | 1817.56333333333 |
| 4 | 1907.33333333333 | 1949.33333333333 | 1966 | 1902 | 1921.68000000000 |
| 5 | 1964.33333333333 | 2003.53666666667 | 2006.61000000000 | 1941 | 1979.43000000000 |
| 6 | 1977.60666666667 | 2010 | 2020 | 1962 | 1991.08333333333 |
| 7 | 1973.33333333333 | 2029.33333333333 | 2044 | 1960 | 1992.22333333333 |
| 8 | 2000 | 2029.66666666667 | 2051 | 1983 | 2023.33333333333 |
| 9 | 41857.7633333333 | 42511.6666666667 | 62992 | 1976.41000000000 | 42152 |
| 10 | 60894.3333333333 | 61759.2133333333 | 61928.6400000000 | 60295 | 61607.3333333333 |

| | | | | | |
|---|---|---|---|---|---|
| 11 | 58373 | 59571.6666666667 | 60295 | 57474 | 59478.6666666667 |
| 12 | 56337.3333333333 | 57277.6666666667 | 57691 | 56017 | 56838.5000000000 |
| 13 | 57236.3333333333 | 58114.6666666667 | 58435 | 56327 | 57463.6666666667 |
| 14 | 57122.6666666667 | 58910.3333333333 | 59272 | 56885 | 58393.6666666667 |
| 15 | 58032 | 59445.3933333333 | 59675 | 57257 | 58714 |
| 16 | 59230.6666666667 | 60171 | 60729 | 58962 | 59706 |
| 17 | 58197.3333333333 | 59054.5866666667 | 59301.7600000000 | 57815 | 58827.6666666667 |
| 18 | 57308.6666666667 | 58703.6666666667 | 58931 | 56637 | 58094 |
| 19 | 54870 | 56068.6666666667 | 56327 | 54188 | 55748.3333333333 |
| 20 | 53320 | 54704.6666666667 | 55583 | 52979 | 54084.6666666667 |

Table 3 (company Aggreko PLC 60 days' last highs and last lows)

(Note: the numbers which are repeated in the table are the last highs or last lows separately)

| Period | Last High | Last Low |
|---|---|---|
| 1 | 1879 | 1683 |
| 2 | 1551 | 1551 |
| 3 | 1909 | 1551 |
| 4 | 1966 | 1551 |
| 5 | 2006.61000000000 | 1551 |
| 6 | 2020 | 1551 |
| 7 | 2044 | 1551 |
| 8 | 2051 | 1551 |
| 9 | 62992 | 62992 |
| 10 | 62992 | 60295 |
| 11 | 62992 | 57474 |
| 12 | 56017 | 56017 |
| 13 | 58435 | 56017 |
| 14 | 59272 | 56017 |
| 15 | 59675 | 56017 |
| 16 | 60729 | 60729 |
| 17 | 60729 | 57815 |
| 18 | 60729 | 56637 |
| 19 | 60729 | 54188 |
| 20 | 60729 | 52979 |

Table 4 (company Aggreko PLC 60 days' confirmation points on directional change)

| Period | Confirmation Point on High | Confirmation Point on Low |
|---|---|---|
| 1 | 0 | 0 |

| | | |
|---|---|---|
| 2 | 0 | 1551 |
| 3 | 0 | 0 |
| 4 | 0 | 0 |
| 5 | 0 | 0 |
| 6 | 0 | 0 |
| 7 | 0 | 0 |
| 8 | 0 | 0 |
| 9 | 62992 | 0 |
| 10 | 0 | 0 |
| 11 | 0 | 0 |
| 12 | 0 | 56017 |
| 13 | 0 | 0 |
| 14 | 0 | 0 |
| 15 | 0 | 0 |
| 16 | 60729 | 0 |
| 17 | 0 | 0 |
| 18 | 0 | 0 |
| 19 | 0 | 0 |
| 20 | 0 | 0 |