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Price and hidden divergences:
An innovative strategy to beat the market

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INTRODUCTION

The financial sector is every day in expansion. One phenomenon which, in recent years, is characterizing significantly the financial markets is the increasing diffusion and application of the principles and methods of technical analysis, in support of investment decisions.

Technical analysis, strictly speaking, is the study of a market exclusively based on the examination of data detected systematically on it, which are usually represented graphically. In another sense, it can be defined as the theory of analysis through which you can try to predict the future trend of the price of a quoted asset (real or financial) studying his past history.

Developed in the United States since the early years of the twentieth century, technical analysis is a set of principles and processes resulting from the experience of analysts and operators. Initially it was used only on the stock markets, but later it has also been applied in the market of commodities, currencies, bonds and other international markets.

This paper aims to investigate the basic concepts and the main tools of this analysis theory in order to apply them into a trading strategy expressly created.

The work is divided into three chapters.

In the first, to provide a general framework, are recalled some general aspects with the presentation and the comparison of the two principal techniques to do an analysis: the fundamental and the technical one. In particular, for the second one are developed the different types of graphs we can find and the most important indicators and oscillator available on the market. These are necessary elements to understand better the trading world, and also the core of this work.

In the second chapter, it is explained the meaning of trading and trading system. To build a good and functional trading strategy it is necessary to go through eight specific steps and consider the three elements of strategy planning (entry and exit, risk management and money management).

In the third and last chapter, it is developed a trading strategy, codified with the program MultiCharts, and it is applied into different markets using historical data. An analysis is made on them in order to find the possible divergences that come from the intersection between the price of the index selected and the Chaikin indicator. The relative results are commented.



CHAPTER 1: GENERAL ASPECTS

The methods used to analyze securities and make investment decisions fall into two very broad categories: *fundamental analysis and technical analysis*.

Before starting with the description of the two categories, it is better to have an explanation of the basic concepts' meaning we will use during the work:

- **ASSETS:** *represents* exactly what a company owns. Generally, a company will categorize its assets based on its business.
- **LIABILITIES (D):** is generally associated to another word: debt. It can be differentiated between long-term debt, which usually includes corporate bonds or other long-term loans, and short-term debt, which usually involves lines of credit from a lending institution, short-term corporate bonds, and accounts payable. Usually, short-term debt is more dangerous to a company's financial stability than long-term debt.
- **EQUITY (E):** reflects what would be left if the company were liquidated and all of its liabilities paid off. An accountant would tell you that a company's assets should be equal to liabilities plus shareholder equity. The reason for this is that the balance (or lack thereof) can give you a sense of how much of the company's business is financed through debt or capital raised by selling shares of stock.
- **EARNINGS PER SHARE:** *it is a number given by* subtracting a company's expenses from revenues, then dividing that number by the shares outstanding.
- **PRICE/EARNINGS RATIO (P/E):** is calculated by dividing the price of the stock into the earnings per share over the last four quarters. The result shows how much higher the stock price is than earnings.
- **MARKET CAPITALIZATION:** is computed by multiplying the current stock price by the shares outstanding. This defines whether a company is categorized as a Large, Mid, Small, or Micro Cap stock.
- **SHARE OUTSTANDING:** all data expressed in per share format is based on the number of shares outstanding.
- **REVENUE:** (also named sales) are an important part of the overall fundamental strength of a company. Even if there is an increment in the earnings, the number which indicates the revenue could be negative or a reduction.
- **DEBT/EQUITY RATIO (D/E):** is a standard measurement that shows how much debt a company carries compared to its shares outstanding. A high D/E ratio generally means the company has borrowed heavily to finance its operations.
- **RETURN ON EQUITY (ROE):** is obtained by dividing earnings for a one-year period by the shareholder equity. It is useful in order to evaluate the ability of



management to effectively use the money that comes in from business operations.¹

All these elements are essential to understand the business of a company, in order to analyze its performance in respect with the rest of the market.

1.1. FUNDAMENTAL ANALYSIS

Fundamental analysts attempt to study everything that can affect the security's value, including macroeconomic factors (like the overall economy and industry conditions) and individually specific factors (like the financial condition and management of companies). Fundamental analysis involves analyzing the characteristics of a company in order to estimate its value. It wants to define the intrinsic value of valued goods: it follows a systematic comparison between theoretical value and real price in the market with the aim of promoting the more consistent positioning strategies; in particular it is focused on underlying factors that affect a company's *actual* business and its future prospects. For example, if the price is higher than the theoretical value, we sell shares; in the opposite situation we will buy them.

The biggest part of the fundamental analysis involves delving into the financial statement, like revenues, expenses, assets and liabilities. Fundamental analysts look at this information to gain insight on a company's expected future performance.

The two levels in which fundamental analysis operates are: structural and particular.

1.1.1. STRUCTURAL LEVEL

A review designed to determine the possible effects of political and economical events at national and international level on these variables which define the valuation's process of a share.

The test is addressed to:

- identify the economic cycles of different period;
- evaluate the fiscal and monetary policy;
- understand the indicators generated by the aggregate of the reference's economic system;
- study the cyclical policy;
- analysis of global effects which directly affect the national economic reality;
- verify the essays regarding inflation, GDP growth, productiveness, unemployment, etc..

The policy of a country is aimed to stabilizing prices, looking for an overall balance to the highest levels of production and employment, to support global economic growth and to balance budget of payments.

¹ All the definitions are taken by: Guide To Fundamental & Technical Analysis, Rich Dad Education, pp. 63-68



1.1.2. PARTICULAR LEVEL

Analysis seeks to identify the economic, financial and patrimonial potentialities of the listed company so that it becomes possible to make forecasts concerning acceptable income flows related to the equity security.

Research follows two lines:

- a) Sector: deepening of the relationship between supply and demand, the measurement of the competition's degree characteristic of the product field;
- b) Enterprise: through the dynamic analysis of the financial statements referred to several accounting periods we proceed to the definition of historical comparisons and prospective evaluations regarding:
 - Economic aspect: ability to generate future income;
 - Financial aspect: ability to maintain an equilibrium between resources and uses;
 - Patrimonial aspect: ability to maintain over time their assets.

First the financial analyst makes forecasts for the economy, then for industries and finally for companies. The industry forecasts are based on the forecasts for the economy and in turn, the company forecasts are based on the forecasts for both the industry and the economy. Also in this approach, industry groups are compared against other industry groups and companies against other companies. Usually, companies are compared with others in the same group.

The various fundamental factors can be summarized into two categories: quantitative and qualitative.

- quantitative fundamentals are numeric, measurable characteristics about a business. It is easy to see how the biggest source of quantitative data is the financial statements. You can measure revenue, profit, assets and more with great precision;
- qualitative fundamentals, these are the less tangible factors surrounding a business.²

One of the assumptions of this study is that the price of the stock market does not fully reflect its "real" value that is known as intrinsic value.

Another one, considering a sort of consequence of the first, is that in the long period, the stock market will reflect the fundamentals. There is no interest in buying a stock based on intrinsic value if the price never reflected that value, especially because nobody knows how long the long period is.

² <http://www.investopedia.com/university/fundamentalanalysis/fundanalysis1.asp>



Fundamental analysis just answers to this question: “Is this a stock I would want to buy?”. This analysis allows to look into the specifics of how a company makes money and how well they execute their business plan.

Fundamental analysis is considered the cornerstone of investing. It's primarily intended for new investors who are beginners with the world of investment and trading.

1.2. TECHNICAL ANALYSIS

Fundamental analysis and Technical analysis are the two main approaches to security analysis. The impossibility to verify the conditions of perfect efficiency in financial market has pushed analysts and operators to seek possible alternative solutions to the optimization problem of the shares in an economic situation naturally unstable. In this way technical analysis was originated. Technical analysis is frequently used as a supplement to fundamental analysis rather than as a substitute to it.

Technical analysis takes a completely different approach in respect with fundamental analysis: it does not care about the “value” of a company or a commodity. Technicians (sometimes also called chartists) are only interested in the price movements in the market so they only study charts.³

According to this technique, the price of a stock depends on demand and supply in the market place. It has little correlation with the intrinsic value. All financial data and market information of a given stock is already reflected in its market price.

Charles Dow is considered one of the fathers of technical analysis. His work started with the publication of a series of articles in the Wall Street Journal between 1900 and 1902. The Dow Theory is aimed to analyze the trend of the global market, by identifying the trend of financial assets and possible reversals.

It is based on six fundamental principles:

- 1) Prices discount everything, they reflect all the information.
It is used by Dow in relation to the closing prices of the stock market session because less influenced to any manipulation;
- 2) The markets are subjected to three types of movement:
 - a. the primary movement is the main one, and can last from less than one year to more years. A bear primary movement corresponds to a long period of decline which starts when investors have no more confidence in the market. Followed by a period of general economic downturn that is the climax when the financial assets are liquidated without considering their intrinsic value.
A bull primary movement corresponds, instead, to a long upward period that can last several years. Usually, it begins after a multi-year bear movement when confidence returns in investors. It follows the phase in which prices react positively to news of economy expansion and culminates with the speculative phase in which financial activities are purchased at a price higher than the intrinsic value;

³ Definition from: <http://i.investopedia.com/inv/pdf/tutorials/technicalanalysis.pdf>

- b. the secondary movement is a period of contrast within the primary movement which may last from a minimum of a few weeks up to several months;
- c. inside the secondary trend may occur minor movements. They last from a few hours to a few weeks and have no predictive value for long-term investors;

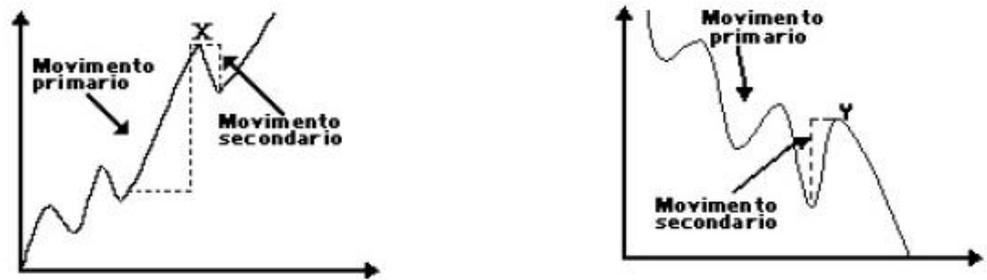


Figure 1.14: Examples of primary and secondary movement

- 3) The "lines" provide movement.
Line is defined as a deviation of the index from its mean, with movements exceeding 5%. This type of movement corresponds to a phase of accumulation, that is an upward trend, when the performance of the index crosses up the line, while corresponds to a distribution phase, that is a downward trend, when you have an increase under the line;

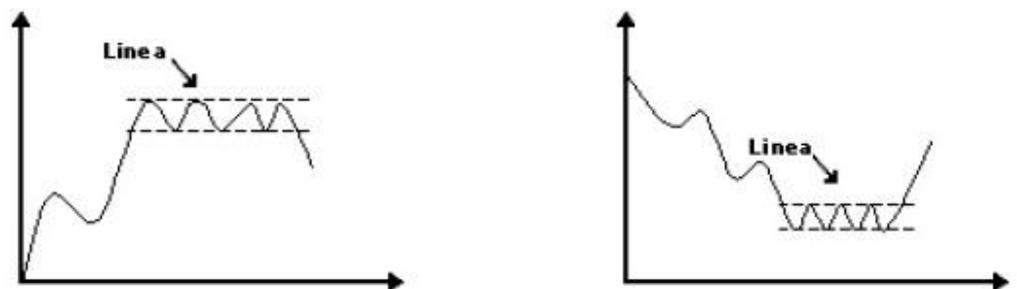


Figure 1.2: Examples of lines provide movement

- 4) The relation prices-volumes.
Under normal conditions, to an ascending trend corresponds increasing volumes; while to a downward trend corresponds decreasing volumes. But, in general, when the volume of trading does not react to an increase in price and vice versa there is a probable inversion signal. The volume of trading in any phase can act as confirmation or warning signal; if the market goes up without volumes it is dangerous, if it goes down without them can be a fix for to mislead the investors, prompting them to sell for fear of losing;
- 5) The price actions determine the trend.

An upward trend is found when the following price's increments exceed previous maximums; the downward trend is, instead, identified when there are series of decreasing maximums and minimums. Indeed, a first inversion signal is when prices fall below last minimum registered in a bull market, or when they rise above the last maximum in a bear market;

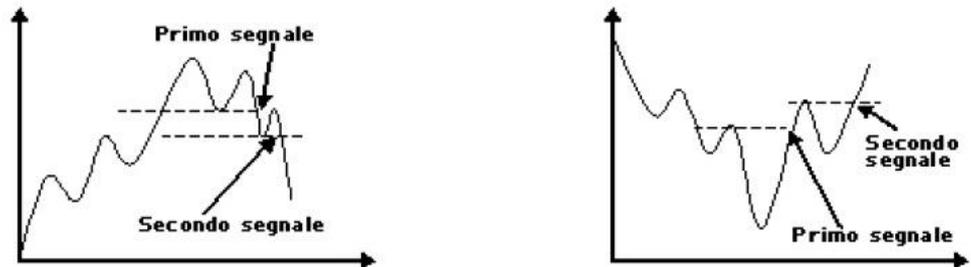


Figure 1.3: Example of how the price actions determine the trend

6) The indices confirm each other.

The Dow Theory has its roots in American market and is based on the assumption that a healthy economy produces and sells its products.

Technical analysts have developed tools and techniques to study past patterns and predict future price, they study only the markets: the technical characteristics which may be expected at market turning points and their objective assessment. With his various tools, the technician attempts to correctly catch changes in trend and take advantage of them.

Technical analysis is directed towards predicting the behavior in probability of a security price. The price at which a buyer and seller settle a deal is considered to be the one precise figure which synthesizes, weighs and finally expresses all factors, rational and irrational, quantifiable and non-quantifiable and is the only figure that counts.

What we can consider as assumptions of technical analysis are:

- the market value of a security is determined by the interaction of demand and supply factors operating in the market;
- demand and supply factors of a security are driven by numerous factors; these factors are both rational as well as irrational;
- security prices move in trends or waves which can be both upward or downward depending upon the sentiments, psychology and emotions of operators or traders;
- present trends are influenced by past trends and the projection of future trends is possible by an analysis of past price trends;
- except minor variations, stock prices tend to move in trends which continue to persist for an appreciable length of time;
- changes in trends in stock prices are caused by a shift in the demand and supply factors;
- shifts of demand and supply, without consider when and why they occur, can be detected through specially prepared charts to show market action;



- some chart trends tend to repeat themselves. Patterns which are projected by charts memorize price movements and then, these patterns, are used by technical analysis for making forecasts about the future patterns.

For doing technical analysis there exist many different ways, which are in practical different point of view, but four are the main important:

- I. Prices: Whenever there is a change in prices of securities, it is reflected in the changes in investor attitude and demand and supply;
- II. Time: The degree of movement in price is a function of time. In probability term, the longer it takes for a reversal in trend, greater will likely be the price change that follows;
- III. Volume: The intensity of price changes is reflected in the volume of transactions that accompany the change. If an increase in price is accompanied by a small change in transactions, it implies that the change is not strong enough;
- IV. Width: The quality of price change is measured by determining whether a change in trend spreads across most sectors and industries or is concentrated in few securities only. Study of the width of the market indicates the extent to which price changes have taken place in the market in accordance with certain overall trend.

To do technical analysis, the most used instruments are the charts also because they are useful to identify trends of the considered stocks: the general direction in which it is headed. Graphical analysis is the most intuitive way to represent the time trend of prices' time series and draw conclusions identifying the main trends and figures. Charts are similar to the charts that you see in any business setting: it is simply a graphical representation of a series of prices over a set time frame. They are based on some elements which can affect the information that is provided. They include the time scale and the price scale.

- *The Time Scale*: refers to the range of dates at the bottom of the chart, which can vary from decades to seconds. The most frequently used time scales are intraday, daily, weekly, monthly, quarterly and annually. The shorter the interval, the more detailed the chart.
- *The price scale*: is on the right-hand side of the chart. It shows a stock's current price and compares it to past data points. A scale can either be constructed in a linear or logarithmic way, and both of these options are available on most charting services. In the first case the distance between each price point is the same in every interval and it does not show the effects of percentage change. Indeed in the second case the distance between points will be equal in terms of percent change.

1.2.1. GRAPHS

Generally, in all charts on the horizontal axis is represented time, while on the vertical axis is showed the price of financial assets. There exist four types of charts in which we can find all of these elements in which the investors and traders make their analysis to have a good result to their trading strategy:

- **LINE CHART:**

It is considered the most basic charts used by market technicians. With it, one simply plots the point of the open, high, low, or close on a chart and draws a line connecting these points: the most commonly used point is the closing price. These charts can show the overall trend of a stock and are very simple to draw. Line charts offer also a clear and easy to read viewpoint of where the stock has been and what pattern it is in. An example of this chart is in figure 1.4.



Figure 1.4: Example of line chart's graph⁴

- **BAR CHART:**

The bar chart is also known as a Western Bar Chart or an OHLC (open, high, low, and close) chart and it gives us a clear representation of what a security has done during a certain period of time.

Each single bar is generally referred to a single day (but it could be referred to any kind of timeframe) and from the figure just below it is easy to see how each single vertical bar is read: the top represents the highest price at which the security traded for during the period in analysis, and the bottom of it the lowest price during the same period.

Generally, during a downday, the horizontal line on the left side indicating the open price is on the top of the bar, and the one on the right side indicating the closing price of the period is on the bottom of the bar. When it is an upday, the

⁴ <http://www.dailyforex.com/forex-articles/2012/03/intro-to-basic-chart-types/11244>

position of the two horizontal lines is inverted: the one of the open price is on the left bottom while the one indicating the closing price is on the right top. It is also possible to find both open and close prices in the top or bottom part of the bar, and still have both a positive day that a negative, because this depends only on their relative position.



Figure 1.5: Example of bar chart's graph⁵

- **JAPANESE CANDLESTICK CHART:**

It is very similar to the bar chart, in fact it has the same pricing information as bar chart, but utilizes a more visually enhanced and identifiable method that resembles a candlestick. The thick part is called the "real body." This real body represents the difference between the opening and closing of the stock (or security) during that time frame and it is fatter than in the bar chart. If the real body of the candlestick is non-shaded, this indicates that the stock closed above its opening price. If the real body of the candlestick is shaded, this indicates the opposite of before. The lines above and below the real bodies are called shadows.

This chart gives much more information on what has happened and what is currently happening, as well as better clues about what is likely to happen next. (See figure 1.6 for a practical example of this type of graph)

⁵ <http://wealthv.com/learn/actionforex/15.htm>



Figure 1.6: Example of candlestick chart's graph⁶

There exist two principal different types of candlestick, one white which is drawn during the updays(bull) and one black which is plotted in the downdays(bear). Figure 1.7 below clearly explains how to read the candlestick and which information about price movements are displayed.

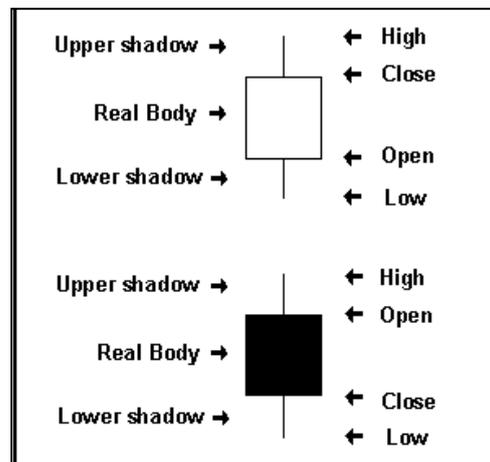


Figure 1.7: Meaning of candlestick's different colors

There are many types of candles which lend themselves to multiple possibilities of reading charts, thanks to patterns that can be formed by a single candle or several candles in series. The most common are long white and black candle, Hammer and Hanging Man, Spinning Top, Bullish and Bearish doji star that are represented in the figure 1.8.

⁶ https://www.lh-broker.com/top-features/Technical_analysis/

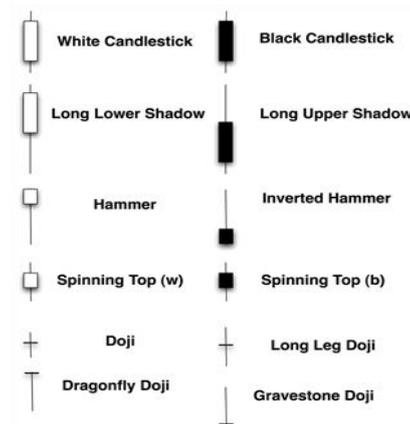


Figure 1.8: Possible candles

Usually, this graph is more common than the other due to its characteristics:

- *Enhanced display*: Candlestick chart build upon the information given from line chart and bar chart. Utilizing the wide variety of patterns that candlesticks can form, we can gain more insight into what is happening in the market than what is provided in any of the previously described chart types.
- *Earlier indications*: Candlestick formations have proven to be quite reliable over time, and when we see certain patterns forming, we can make better decisions quicker also because it tells us what happened and gives an indication of what is likely to happen in the near future.
- *Easy to understand*: Anyone (both a scholar and a professionals) can learn to interpret candlestick patterns and their meanings.

In conclusion, these three types of charts most used in the trading system but it is possible to find also the last one, due to its particular characteristics.

1.3. COMPARISON AND DIFFERENCES BETWEEN THE TWO TECHNIQUES

Summarizing in the following table the two techniques we saw, we have:

FUNDAMENTAL ANALYSIS	TECHNICAL ANALYSIS
Preamble	
- Market price represents the effect of concomitant causes that must be identified and assessed	- Market price represents the ideal synthesis of causes that do not need to be isolated and evaluated
Aims	
- Verify the intrinsic value of listed good in order to promote selected actions	- Detect early and terminal trends and historical recurrence of cycles with different time horizon



<ul style="list-style-type: none"> - Ensure a constant review of the relationship between the current price and intrinsic value to facilitate policies positioning 	<ul style="list-style-type: none"> - Identify the appropriate time for the assumption of speculative positions
Properties	
<ul style="list-style-type: none"> - Need for product specialization that prevents iterability analysis and the opportunity to establish relationships between assets, sectors and different markets 	<ul style="list-style-type: none"> - Adaptability to any market which implies the possibility to operate speculative interventions in environments with marked directionality and to make comparisons between goods
<ul style="list-style-type: none"> - Validity refers only to long-term speculative actions and strategic guidelines 	<ul style="list-style-type: none"> - Validity refers to projects of any time horizon and for both tactical and strategic guidelines
<ul style="list-style-type: none"> - Require the availability of a significant amount of data and thorough knowledge of economic theory 	<ul style="list-style-type: none"> - Requires only the availability of data regarding prices and volumes
Instruments	
<p><u>Equity security</u></p> <ul style="list-style-type: none"> - Macroeconomic assessments and evaluations regarding the capital structure, economic and financial situation of the listed company; - Models aimed to the estimation of potential profitability <p><u>Exchange ratio</u></p> <ul style="list-style-type: none"> - Procedures of dynamic comparison between macro variables, such as: balance of payments, level of internal and external interest rates, sages of inflation etc. related to participating countries to commercial and financial trade <p><u>Raw material</u></p> <ul style="list-style-type: none"> - Investigations relating to the components of supply and demand; - Identification of the typical seasonal factors; - Market research and analysis 	<ul style="list-style-type: none"> - Time series analysis of shares' prices, of exchange rates and prices of raw materials through: <ol style="list-style-type: none"> a. Econometric models b. Statistical techniques applied in time and frequency domain c. Heuristic systems, such as: <ol style="list-style-type: none"> c1. Graphs, to study <ul style="list-style-type: none"> • trends over the short, medium and long term • stages of congestion • characteristic configuration • tactical and strategic objectives • quantities traded c2. Quantitative, to study <ul style="list-style-type: none"> • Rapidity, acceleration, volatility, directionality and relative strength of price movement • Overbought and oversold • Optimal levels of sale • Protection levels of speculative positions taken



The two techniques are the two main schools of thought in the financial markets. As mentioned before, the first one looks at the price movement of a security and uses this data to predict its future price movements. The second one looks at economic factors, known as fundamentals.

And, if we want to find the differences between them, it is possible to say:

– *Charts against Financial Statements*

A technical analyst approaches with the use of the charts, while a fundamental one starts with the financial statements by looking at the balance sheet, cash flow statement and income statement, and he tries to determine a company's intrinsic value.

In this approach, investment decisions are quite easy to make: if the price of a stock trades below its intrinsic value, it's a good investment. Technical traders, on the other hand, believe there is no reason to analyze a company's fundamentals because these are all accounted for in the stock's price and all the information they need are in the charts.

– *Time Horizon*

Fundamental analysis takes a relatively long-term approach to analyzing the market compared to technical analysis. While technical analysis can be used on a timeframe of weeks, days or even minutes, fundamental analysis often looks at data over a number of years.

The different time horizon that these two approaches use is a result of the nature of the investing style to which they each adhere. When a fundamental analyst estimates intrinsic value, a gain is not realized until the stock's market price rises to its "correct" value because it can take a long time (several years, in some cases).

Furthermore, the results and the numbers that a fundamentalist analyzes are only based over long periods of time. Financial statements are stored quarterly and changes in earnings per share do not emerge on a daily basis like price and volume information.

Finally, another reason because fundamental analysts use a long-term timeframe is that the data they use to analyze a stock is generated much more slowly than the price and volume data used by technical analysts.

– *Trading against Investing*

The goals of a purchase (or sale) of a stock are usually different for each approach. In general, technical analysis is used for a trade, whereas fundamental analysis is used to make an investment. Investors buy assets they believe can increase in value, while traders buy assets they believe they can sell to somebody else at a greater price.

1.4. HOW TO EVALUATE THE PERFORMANCE OF A STOCK

To evaluate the performance of a stock should be used jointly more techniques in order to identify with a good degree of certainty reversal signals of trend.

First of all, we have to know that the trend can take three directions: upward (up trend), downward (down trend) and lateral (sideways trend).

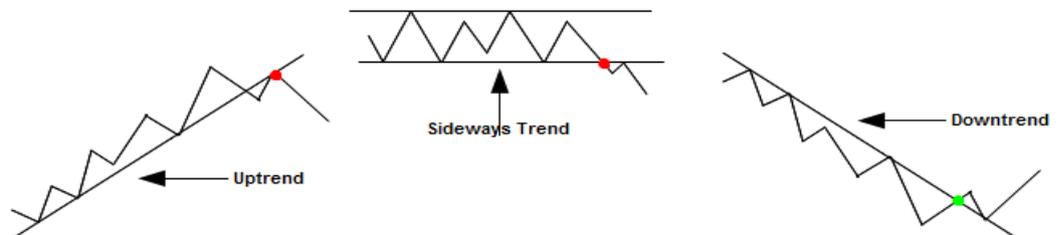


Figure 1.9: Different types of trend

Then, considering the Dow Theory, we can have a trend of three types: the primary, long-term trend (usually more than one year); secondary, fixes the medium term primary trend (time horizon from some weeks to one year); minor corrections in the short term secondary trend (from some days to some weeks). Trend lines are the simplest tools used in technical analysis to determine the direction that prices are following in a certain period of time and they form the common basis for the application of more complex methods.

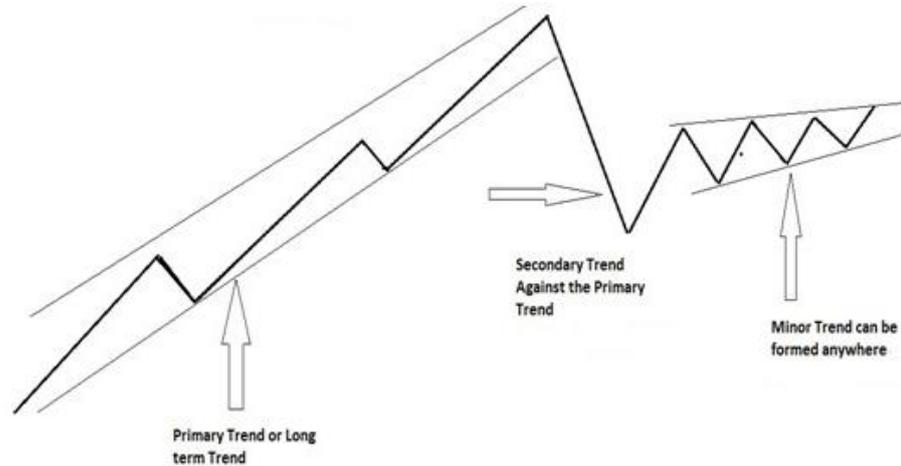


Figure 1.10: Types of trend in Dow Theory

Among the basic concepts you need to know to make an analysis, concepts of support and resistance, the analysis and the recognition of price patterns and trends, the use of moving averages have particular importance.

At a deeper level, the use of more complex indicators, known as oscillators, is able to study the strength of the internal market and to capture in advance the first signs of reversal.

The concepts of support and resistance are critical in technical analysis.

The price at which the trading takes place is the synthesis of supply and demand on the market, which is a “consensus”, a price at which sellers are willing to sell and buyers to buy.

Buyers are “bullish”, they think that prices will move upward, while sellers think instead that prices will move downward, they are bearish.

Support means that the price level at which most investors think the stock will tend to push up the price, without going down that level. It is, therefore, an area in which the demand of the buyers is able to cope with the supply of sellers and stop the descent of the title.

Resistance is instead the price level around which investors think that the rise of the title will stop without go further, therefore, an area where predominates the strength of the sellers on the market.

If a support level is broken, it becomes a resistance level. If a resistance level is broken, it becomes a level of support. This because the market is reminiscent of past levels: sellers and buyers placing their orders to buy and sell at technical levels, making them particularly important.

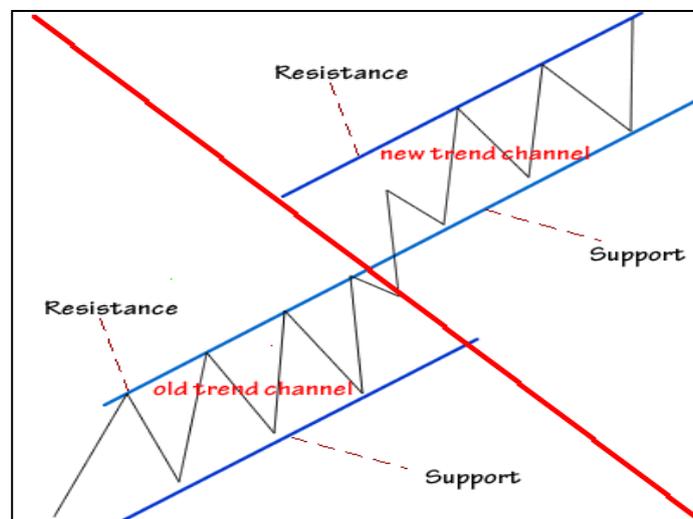


Figure 1.11: Example of how supports and resistances work

We can differentiate “static” levels of support and resistance when they match to a precise and constant over time point from “dynamic” ones in the case of a “trend line” or “line of the channel.”

Other important aspects we may find reading a graph are channels.

The channel concept is the natural evolution of the trend line. It is built simply by creating two parallel lines that act as strong areas of support and resistance in the trend line defined. These lines must pass through at least a point of relative maximum in the case of a bullish trend and for at least one point of relative minimum in the case of bearish trend. The channel, compared to the trend line, provides the concept of market depth, delimiting, therefore, a well-defined oscillation band (channel width) within which the prices tend to move.

Channels have greater importance and therefore most likely to deliver operating signals valid, as many times the graph title rests on the ends of the channel without leaving it.

Through the graphical analysis, it is possible to detect particular movements of price, which can forecast future behavior. The basic distinction between the different types of figures is adapted to separate models continuation pattern from those of reversal pattern.

Continuation patterns are movements that represent a temporary slowdown trend. Usually, they develop in the intermediate stage of well-defined trends; once it concluded the figure of the time, prices shooting to move in the direction of the original trend. The most common are: “triangles” are the most common and familiar to technical analysts, but also less reliable, since they can be either a continuation of that reversal of the current trend, “rectangles” prefigure, in general, just stopping over the current trend in which prices are moving in two parallel horizontal lines, “wedges”, similar to the triangle, differ from these because both sides appear to have the same inclination, upwards or downwards, “flags” is characterized by being very short and narrow.

Reversal pattern, however, are figures that announce a probable reversal of the direction of prices. Among these the most common are: “Head and Shoulders” occurs at the peak of an uptrend: quotations draw on the graph a first maximum (left shoulder) followed by a quick reversal, “Inverse Head and Shoulders” is exactly the mirror of “Head and Shoulders”, “Double Top” is a figure composed of two maximum separated by a temporary decline in prices and “Double Bottom” is the figure mirrors the double top, “V-Formation” takes place at the end of a secondary trend and it is characterized by a dramatic increase in volumes, “Diamond” is presented as an expansion figure which is followed by a symmetrical triangle.

- **Triangles:**

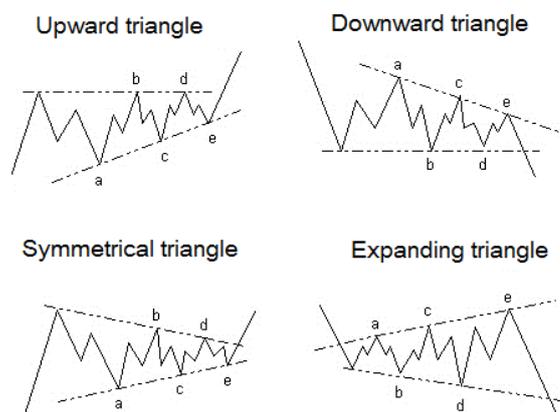


Figure 1.12: Examples of triangle figures

The triangles continuation occur in the intermediate phase of a trend and you draw on the graph drawing two trend lines that enclose the share price and that converge towards a meeting point (called apex) of the triangle. The first target price of these figures, once completed, is obtained by drawing the parallel to the trend line support projecting from where the triangle

originated. The next objective is calculable projecting from the break point of the figure the width of the base of the triangle.

Symmetrical triangle consists of a series of lower highs and higher lows. Graphically you can see how joining relative maxima and minima will lead to the creation of subsequent lines of support and resistance. These types of triangles are also called "coil" because the quotations suffer a progressive contraction in a well-defined space, up to rupture of the straight line of support or resistance. The bullish triangle is formed by a horizontal static resistance which hinders the attempts to rise in the title, while the trend line that connects the relative minima is inclined upwards. The bearish triangle is formed by a horizontal static support, while the trend line that connects the relative maxima is inclined downwards.

- **Wedges:**

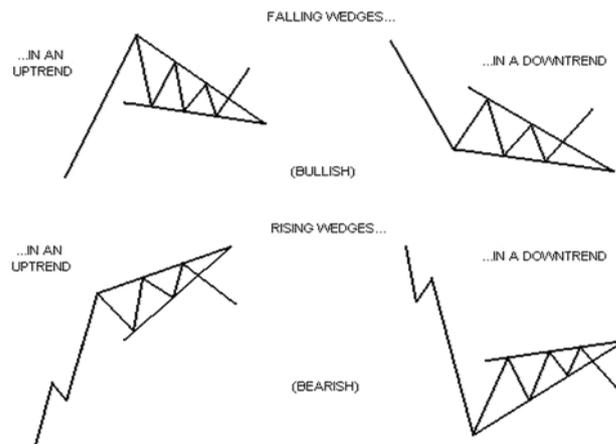


Figure 1.13: Examples of wedge figures

We can have two different types of wedge, continuation or reversal of the current trend. Wedge as continuation figure: it develops with opposite inclination to trend from which it originated. Wedge as reversal figure: it develops with the same angle of the trend from which it originated. Usually these figures are completed in a fairly limited time frame.

Usually the volumetric trend has low exchanges during the formation of the figure, while at the breaking, exchanges increase very rapidly. The target price of these figures is calculated by projecting the width of the base of the wedge from the break point.

Very often, when we find a wedge, regardless of its inclination, after a strong increase (decrease) it announces the conclusion of the current trend, thus anticipating a possible trend reversal. Unlike the triangle, here prices remain locked up in the figure at the apex.

- **Flags and pennants:**

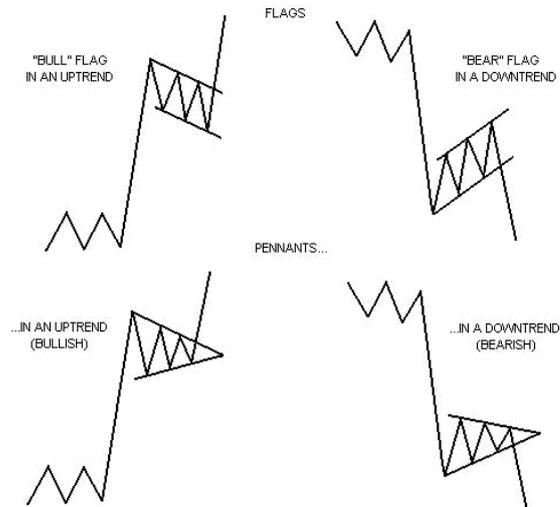


Figure 1.14: Examples of flag and pennant figures

Pennant is a technical figure very similar to the wedge. It is a continuation figure of the current trend that will last up to several weeks and is has inclination contrary to the trend. Usually once concluded the figure, the breakout is characterized by a sharp increase in trading volumes. The target figure is determined by reversing from the breaking point all the increases (or decreases) of the previous year: the excursion in prices is called “auction”.

Pennants occur after a violent movement and tend to cause a development of the prices into a channel against the direction of the main trend. Only after the perforation of the channel side, which serves as resistance (in the case of a bullish trend) / support (in the case of bearish trend), you have the recovery of the main trend. Unlike the pendant, the flag has mutually parallel sides of the figure. All views expressed by the pennant also apply to the flags.

1.5. INDICATORS AND OSCILLATORS

The algorithmic analysis is based on the construction of indicators that process, from a statistical-quantitative point of view, passed data with the aim of supporting graphical analysis.

Indicators are algorithms that measure the strength of a trend through mathematical formulas whose results are represented by a graph that is used in parallel with the standard of the prices; these instruments are used to confirm the existence of a trend, to measure its strength and then to understand the times when this is going to end and has been next to a change of direction.

Inside indicators are distinguished oscillators, called in this way because the graph derived from these algorithms moves within horizontal bands between zero and one hundred. The value of the oscillator becomes important because its location against two horizontal default bands indicates the overbought or oversold levels.



We are in case of overbought when the demand clearly prevails supply causing a continuous and fast increase in prices feature more consecutive bullish sessions. Instead, we have an oversold when the offer prevails causing a faster drop in prices. Consequently the aim is to identify the end of this movement for having the signals of inversion in bullish optical.

Indicators are used because they alert you when prices have moved too fast in one direction and then show us, for example, that an upward trend cannot continue in that way, but will present a phase of reversal of trend, at least of short period.

The operating signals given by the oscillators are common to all the indicators and they are generated by the output from the bands: in particular the output from the top down from the overbought zone provides a sell signal, while the output from bottom up from oversold band produces a buy signal. Once the oscillator falls into the neutral range is concluded on previous movement of hyper traded and then you work expecting a trend reversal. Other leading signals may also be flattening of the oscillator over the aforementioned overbought and oversold bands.

For indicators, which do not have bandwidths, signal acquisition /sale are provided by the intersection with the value zero.

A further sign of the trend reversal is given by the divergence between the performance of the price and the indicator.

Then we proceed to describe the main algorithmic analysis tools. These, according to the data they use, can be divided into two categories: those which consider only the price (i.e. Momentum, ROC,...) and those which consider both the price and the volume (i.e. MFI, A/D, ...).

➤ **MOVING AVERAGES (MA):**

They are in class of trend indicators and they are used to mitigate excessive price volatility, eliminating or reducing the incidence of the minimum and maximum in the short term which may lead to evaluation errors. For moving average it means an average defined on a number N of closing prices, which is periodically updated by replacing the oldest data with the latest data in chronological order. The series moving average will look much smoother the more are such periods used to build it. The most used for analysis are those: 25 days, 50 days and 200 days which respectively represent the short, medium and long term. A rising moving average is a good indicator of a strong market, while a descending one denotes weakness. Its comparison with the price index, however, shows that the moving average changes direction far from the maximum or minimum stock price and the signals are then inevitably lags behind the price performance not allowing taking full advantage of the trend. At the time when the price level cuts a moving average signals of sale or purchase are generated.

The long term moving averages are the best in case of persistent tendency, whereas those with a short term are the most useful in the case of reversing. Hence the idea of using simultaneously two moving averages of different lengths: the long one indicates the ongoing trend while the short one indicates the operating signal. The intersection of more averages of different length

between them not only is an operating signal, but also the confirmation of the inversion of the trend.

The following different types of moving averages used in technical analysis:

- *Simple Moving Average (SMA):*

$$SMA_n = \frac{\sum_{i=1}^n P_i}{n}$$

also said arithmetic, are calculated by adding up the total of a series of data and then dividing by the number of observations, obtaining as a result an arithmetic mean; to make them mobile every day it is deleted the oldest price from the data in the series to introduce the current price: the new total is again divided by the number of observations, and the mechanism proceeds gradually, thus obtaining a continuous line. The simple moving average is criticized for the fact that assigns equal importance to each data, regardless of the timing of the same.

Changes in the trend of the stock are not identified only by the change of direction of the moving average, but also by the intersection of this with quotations.

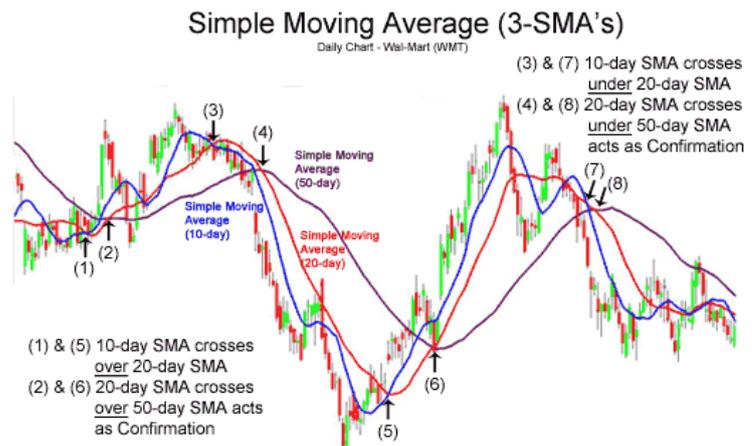


Figure 1.15: Example of how SMA works in MultiCharts⁷

- *Weighted Moving Average (WMA):*

$$WMA_n = \frac{\sum_{i=1}^n P_i * i}{\sum_{i=1}^n i}$$

Here, the weighted sum between the total of a series of data and their weights is then divided by the sum of the weights. It is given more weight to the latest data thus solving the problem of the late reporting of inversion found in simple moving averages. This method proves to be more effective than the previous one to identify trend

⁷ Figure taken by: <http://www.onlinetradingconcepts.com/TechnicalAnalysis/MASimple2.html>

reversals, but keep in mind that in this case the signal is not given from the intersection with the line of the quotes, but by the change of tendency of the same media.

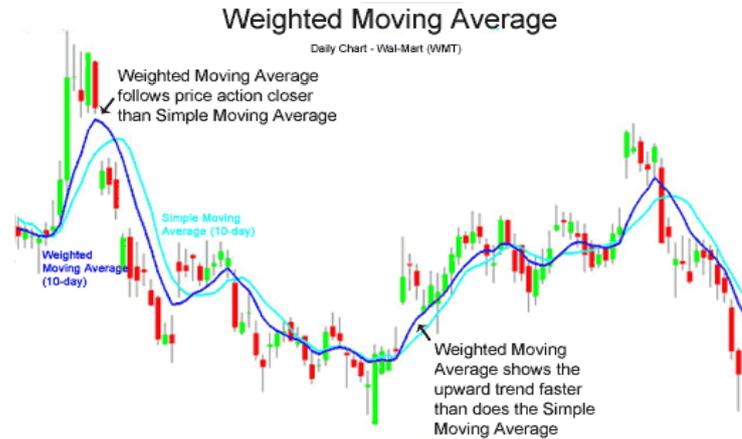


Figure 1.16: Example of how WMA works in MultiCharts⁸

➤ *Exponential Moving Average (EMA):*

$$EMA_t = P_t * \phi + (1 - \phi) * EMA_{t-1}$$

$$\text{where } \phi = \frac{2}{n + 1}$$

Even in this case it is given greater weight to more recent observations; the law used to discount the data is exponential and this approach is usually preferred to both of the previous. Instead of using a fixed number of observations are used all the data that you have, which is exploited all the history of the stock. The greater importance to be given to recent data is obtained by taking into account all the elements of the series, with an exponentially decreasing weight until you get to infinitesimal values for the oldest values and who will be included in the calculation.

⁸ Figure taken by: <http://www.onlinetradingconcepts.com/TechnicalAnalysis/MAWeighted.html>

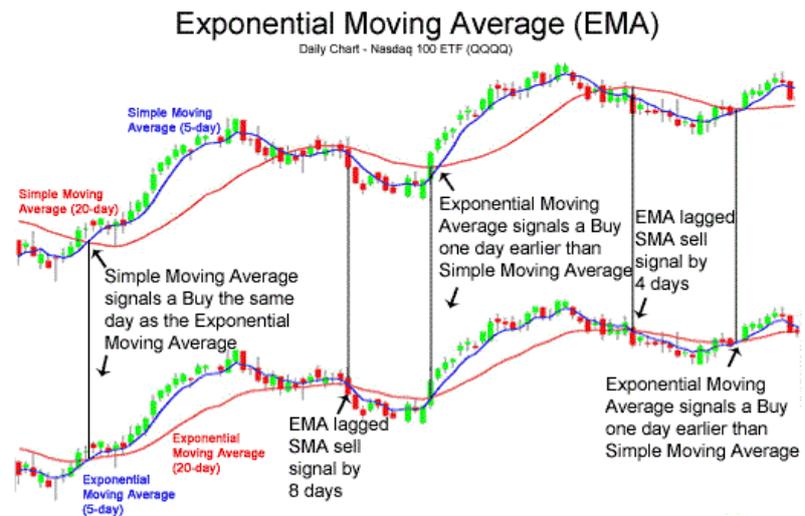


Figure 1.17: example of how EMA works in MultiCharts⁹

➤ **MOMENTUM:**

$$Momentum_t = P_t - P_{t-n}$$

It measures the rate of change of prices compared to their actual levels. It is calculated as the difference between the current price and that retained n periods before and it allows evaluating the speed and acceleration with which prices change so you can get a confirmation with respect to the strength of the current trend.

If the momentum following the direction of the trend means that the trend involved is solid and that is accelerating, and this movement is likely to continue. If $M > 0$ there is the presence of expansive evolution of the market, increasing values (decreasing) of M indicate a strengthening (weakening) of the current uptrend; if $M < 0$ represents a declining evolution of market, increasing (decreasing) values of M point to a strengthening (weakening) of the current downtrend. For its simplicity, it is not always accurate and sometimes provides false signals, for example when it generates the erratic movements due to a sudden change of values. Another shortcoming is that they do not possess confidence bands to indicate the levels for the operation, which we have only with the perforation of zero.

⁹ Figure taken by:
<http://www.onlinetradingconcepts.com/TechnicalAnalysis/MAExponential.html>



Figure 1.18: example of how Momentum works in MultiCharts¹⁰

➤ STOCHASTIC OSCILLATOR:

$$\%K = \frac{(P_{current} - P_{min})}{(P_{max} - P_{min})} * 100$$

$$\%D = SMA(K)$$

It is based on the assumption that, in an upward trend, closing price of the trading day is very close to the maximum values of the same day, while in a downward trend, closing is next to minimum of the day. It thus becomes an alternative method to find out the approach of the points of support and resistance within the period considered.

The creation of the oscillator in two stages: the first for the creation of the line of the %K line, the more sensitive to price and also the faster and more volatile, and the second for the creation of the %D line. To calculate the %K, you should be subtracted from today's closing price the minimum value of the period considered, while the %D is just a simple moving average of the 3order of %K, slower and less volatile because it is less sensitive to prices. For definition %K and %D fluctuate between 0 and 100: values close to 100 indicate that the stock is the highest of the observation period (generally 14 days), while values close to 0 indicate that the stock is at its lowest. The hyper bought is generally identified in excess of 70/80%; the extremely sold to the below d 30/20%.

The signal is more significant if the intersection takes place, respectively, in the range of oversold or overbought. Finally, you can go looking for divergences, that is, patterns of price trends in contrast with the trend in the oscillator: in downtrend, positive differences of %K and %D to give reliable signals of purchase, and vice versa in an uptrend, negative divergences give sell signals.

¹⁰ Figure taken by: <http://www.onlinetradingconcepts.com/TechnicalAnalysis/Momentum.html>



Figure 1.19: Example of how fast and low stochastic oscillator works in MultiCharts¹¹

➤ BOLLINGER BANDS

$$\%b = \frac{(P - banda_{inf})}{(banda_{sup} - banda_{inf})}$$

$$BW = \frac{(banda_{sup} - banda_{med})}{banda_{med}}$$

They are considered an indicator of the volatility of a security, that is, the magnitude of price fluctuations, which can signal a turnaround. They are composed of curves obtained exclusively with the time series of a stock price: a simple moving average of N periods (center line), usually of 20 periods, which can be months, days, hours, etc. ; the moving average to which is added twice the standard deviation (upper band), and one to which it is subtracted (lower band). It is thus obtained a figure in function of time in which the values of a stock are generally between the bands.

It is possible to notice that the more prices become variable the more the two bands tend to diverge, contrary to when it is in presence of a state of congestion, wherein the width of the bands decreases. As regards the operating signals that this indicator provides, when prices touch on the upper band often indicates an excessive growth, in terms of recent deviation standard, for which we expect a rebound within the band. Similarly with regard to the breaking of the lower band, this indicates an excessive fall in prices that is trusted to note a following rebound within the band. The more the band top/bottom is perforated up/down, the more it becomes a downward/upward inversion signal. To support the graphical representation, the system Bollinger also provides for the use of indicators. The first, %b, indicates the point where we are compared to the bands. If the value is 1, 0.5 or 0 it means that we are in the upper band, in the moving average or in the lower band, respectively. The second indicator derived from the Bollinger Band is the Bandwidth, BW. It is useful to identify the squeeze, the situation in which the volatility has fallen to a

¹¹ Figure taken by: <http://www.onlinetradingconcepts.com/TechnicalAnalysis/Stochastics.html>

so low level as to suggest an imminent increase. A break of the trading range, accompanied by a clear expansion of bandwidth, is often the starting signal for a trend to last.

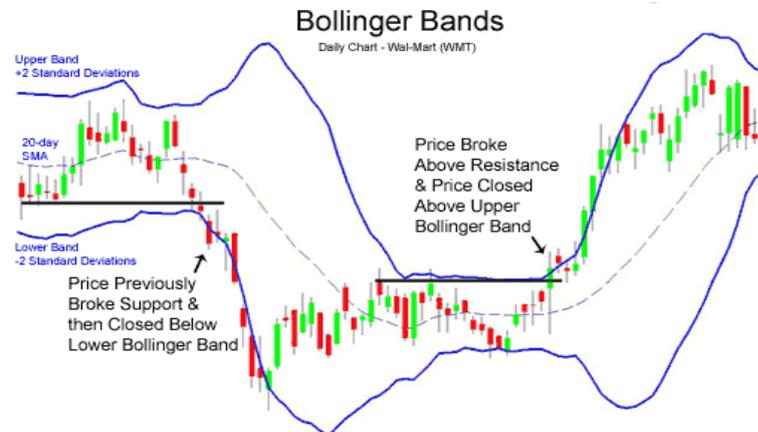


Figure 1.20: Example of how Bollinger bands works in MultiCharts¹²

➤ ACCUMULATION/ DISTRIBUTION

$$A/D = \frac{(P_t - P_{min}) - (P_{max} - P_t)}{(P_{max} - P_{min})} * V_t$$

It is an indicator that associates the variation of prices to the volume, with the aim to identify the conditions of the market dominated by buyers (accumulation phase) or by sellers (distribution phase). It is based on the premise that the greater the volume that accompanies a movement of the price, the more significant is the movement itself. When A/ D moves up, it shows that we are witnessing a phase of accumulation on the considered stock so most of the volume is associated with price movements directed upward. Instead, when the indicator moves down, it shows that we are witnessing a stage of distribution on the stock, and in this case most of the volume is associated with bearish movements. Divergence between indicator and the price of the financial asset considered implies that a trend change is imminent. When there is a divergence, prices usually change confirming the signs of A / D.

¹² Figure taken by:

<http://www.onlinetradingconcepts.com/TechnicalAnalysis/BollingerBands3.html>

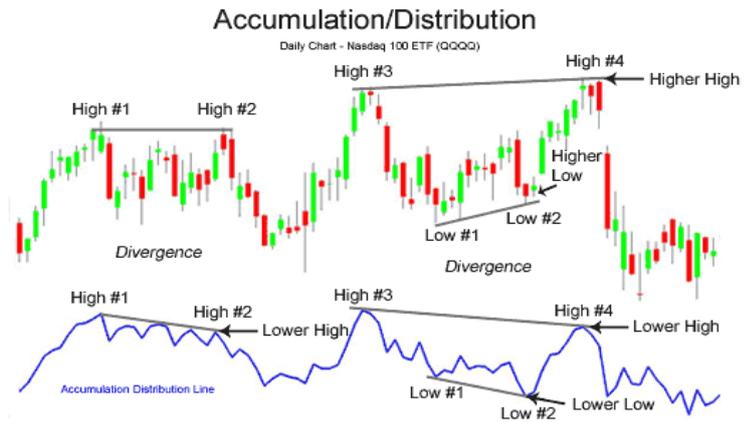


Figure 1.21: Example of how A/D works in MultiCharts¹³

¹³ Figure taken by:
<http://www.onlinetradingconcepts.com/TechnicalAnalysis/AccumulationDistribution.html>



CHAPTER 2: SYSTEMATIC TRADING

In the last chapter I analyzed all the fundamental and key aspects necessary to understand a little better the world of trading. I developed the concepts of fundamental analysis and technical analysis: the first provides the conditions for the selection of the title, while the second provides the appropriate timing for the entry. Both are often used by those who are particularly interested in the long term operation. Notice that in intraday operations fundamental analysis has no value, because the fair value does not emerge, but it is apparent only in the medium or long term.

Now it is important to clarify what we mean by the term trading.

2.1. WHAT TRADING IS

Trading comes from the verb to trade which means the act or process of buying, selling, or exchanging assets with the aim to make a profit.

International markets have evolved throughout history with the objective to minimize the impediments to trading due for example to the distances between buyers and sellers, to increase the security of transactions and to ensure continuity and regularity to the big commercial exchanges. In this way they were born the daily exchanges, such as the Royal Exchange in London in 1773 (today known as the London Stock Exchange) and that of Wall Street in New York in 1792, which led to a rapid shift of capital through the exchange of securities of ownership of goods or companies.

The economic process of optimizing the allocation of resources has thus evolved into the financial management of the money to get the most profit by buying and selling stocks, bonds, currencies, commodities and relative derivative instruments, which is precisely the transactions of someone who trade.

This term is therefore required in the financial sector and with the birth of Internet was born also the online trading, that is the ability to manage our own assets and to continuously put orders in the electronic market, directly from home or office, while remaining connected to the network.

We can distinguish different types of trading, depending on the life span of a trade:

- purchase something and sell it within a few minutes: SCALPING;
- in and out in a few hours, and in any case within the same day: INTRADAY TRADING;
- a trade that lasts some days: MULTIDAY TRADING;
- about a month: POSITION TRADING;
- several weeks or years: LONG TERM TRADING.



Depending on the duration of the operation we will have different types of trading. Each type of trading requires different skills and needs a different set of analysis' tools. Trading without establishing the type of approach one is willing to follow is a very common mistake in inexperienced investors. The choice in terms of the type of trading that you want to practice depends on several factors, personal inclinations above all. The best approach for each investor can be figured out only trading on the markets for a while.

2.2. WHAT A TRADING SYSTEM IS

A trading system is automated information processing on a set of financial instruments, which provides the operating signals, that is, the indications on the orders of buying and selling to be marketed and allows beginning and closing a certain position in the market. The system is therefore made of software that applies a proven methodology systematically.

This scientific and disciplined approach that determines the operation is the key to a winning investment, since it eliminates the emotional component of the investor, which is, on the contrary, most of the time, the main cause of failure.

The implementation into the computer of a trading method allows simulating such behavior, by applying it to the historical series of financial instruments, so to be able to check the results that would have been obtained in the past. When a strategy proves to be effective on past data, as a result we obtain an automatic trading system.

The information provided to support a trading system mainly concern:

- the historical series on which you can use technical analysis and compute correlations, various oscillators and indicators;
- the data from the electronic market (prices, volumes and order book in real time);
- the sector indices;
- indicators that are derived from fundamental analysis and news price sensitive.

Finally, the heart of the trading system is made up of the portfolio management, that is, diversification of financial investments weighted according to the relationship between expected returns and relative risk. The trading system has become the decision-making system that guides the choices of fund managers, investment companies and professional traders.

We can distinguish two types of approach to the market:

- discretionary: is based, essentially, on the operator's ability to filter and process all information available in order to determine the quality and the size of the operation that is going to accomplish. This activity is never equal to itself as, in time, not only changing the evaluation criteria of the variables but also the variables themselves, being the set of information available not constant,



because it is based on data streams that are not always continuously updatable, or that, in some cases, are even occasional;

- systematic: wants the data upon which to base decisions are defined a priori and that the same is done with the criteria for the analysis of such data. The rules must be clear and precise and allow determining the timing and extent of the positions to be taken, forecast a strategy for risk management and capital protection.

The code allows, then, to escape to the disorder typical of many traders, as the structuralism of the trading plan helps the achievement of a greater degree of discipline. The need to clarify in a complete manner the rules for opening and managing positions means that the operator knows, with greater clarity, the principles that himself has placed at the base of his activity and, consequently, is easier to comply with these principles. Compliance with the default rules is absolute in the case of fully automated systems, where the computer itself forwards the order to the intermediary.

It is possible to summarize the advantages and limitations of trading systems in the following table:

ADVANTAGES	LIMITATIONS
<ul style="list-style-type: none">• Do not allow inconsistent or ambiguous strategies• Allow the achievement of greater discipline• They are not subject to emotions• They can be tested• Allow earning systematically	<ul style="list-style-type: none">• They are not able to analyze, in a satisfactory way, any kind of information• They are not always able to adapt adequately to changing conditions that alternate in the financial markets

If we want to build a system, we have to know the different types. We can then distinguish:

- Trend following systems: They aim to gain from big price movements. Generally, they rely on instruments capable of recognizing the phases of strong directionality (moving averages, MACD, etc.). They generate a low percentage of profitable transactions. During the phases of lateral movement, they are not profitable and require, therefore, in order to be implemented, a capital able to withstand even long periods of losses.
- Counter trend systems: They are built to identify the points of reversal of the direction of price movement. Based oscillators or levels of support and resistance variously defined, they are particularly effective during lateral trends. Generate a high percentage of profitable operations characterized by small profits.
- Pattern systems: These systems generate signals of buying and selling following the formation, on the price chart, of one or more particular configurations that



are believed to anticipate the movement of a certain entity. Used primarily for the short operation, these systems are limited in the difficult translatability in algorithmic terms of some patterns on which they are based. These, in fact, are generally defined in their general lines according to the sensitivity of the operator the task of recognizing them in the series of prices. It is difficult, then, surround the main features of a configuration, if too generic and approximate, in a formula that requires clear and precise inputs.

- d. Integrated systems: they are not an independent category as there are no more than the set of multiple systems of different structure. These aim to exceed the limit of the inability to adapt to changing market conditions, by integrating the signals of multiple trading systems, each of which is better adapted to different scenarios that can characterize the price of a security. The problem, here, is “only” to identify a rule-filter that determines the activation of a system rather than another.

2.3. HOW TO BUILD A TRADING SYSTEM

As everything, a trading system has to start with an idea and if it is good, then, to build and use a trading strategy in order to produce wealth, eight steps are necessary, and they are:

1. conceptualize and formulate the trading strategy;
2. specify the rules of trading in a definitive, objective and verifiable way;
3. perform a preliminary form of trading strategy's control;
4. optimize the trading strategy, which means arrive at the formulation of the strategy so that it can achieve the most robust and high level of return adjusted to the risk;
5. investigate the robustness of the trading strategy and its ability to generate profits in real trading;
6. trading the strategy in real-time;
7. monitor the performance of trading and ensure that it is consistent with the performance resulting from historical simulation;
8. improve and refine the trading strategy.

Each step is strictly related to the previous one (see also the related figure below).

1. *Conceptualize and formulate the trading strategy*

The rules that make up the strategy must be thoroughly examined one by one. The strategy can be as simple or complex as you want, but the important thing is that you can explain the strategy completely and consistently. In its final form a systematic trading strategy must be reduced to a set of rules and precise formulas, otherwise it is not a systematic trading strategy.

2. *Specify the rules of trading in a definitive, objective and verifiable way*



If all the trading rules were written and organized in a coherent, logical and consistent format, this step is appreciably easier. In order that the strategy is verifiable, it has to be translated into a language that the testing platform chosen may be able to understand. An example of platform could be MetaStock, TradeStation, TradersStudio and MultiCharts, which have all their specific writing languages and their peculiarities. The last, in particular, is the program I will use for my analysis.

EasyLanguage is the development language of TradeStation and MultiCharts, and it is an evolution of a now disappeared programming language: Pascal. The language of writing object-oriented TradersStudio is especially recognizable by all those who are accustomed to Visual Basic. Those who are accustomed to Excel formulas could be well at ease with MetaStock.

3. Preliminary form of trading strategy's control

Trading strategy is now codified in a form that can be verified, with two clear targets in mind: the first is to determine whether the trading strategy does what it has been designed for; the second is to obtain a preliminary assessment of the performance of trading.

4. Optimize the trading strategy

Optimize means to make the best possible use of the trading strategy, that is achieve through it the best possible outcome of risk-adjusted profit. Optimization has some pitfalls: to know how to properly optimize a trading system allows you to fully understand your own strategies and gain maximum profit. Optimization is easy to understand, and with modern software is also simple to do. But it's almost impossible to optimize a strategy without understanding its logical principles. The optimization process involves the creation and analysis of a simulations' group of the performance of the trading obtained using a selected range of different combinations of the model parameters on the same set of historical price data. The optimization process selects a restricted set of optimum models by this wider group of test results based on an objective function.

This level of verification is considered satisfactory if the performance has grown considerably in all markets in which the strategy has been verified. Another feature worthy of note is the possible onset at this stage of features that suggest a certain robustness of the strategy.

5. Investigate the robustness of the trading strategy and its ability to generate profits in real trading

The trader in this phase of the process determines whether the trading strategy is real or not. It determines whether the hypothetical returns that have been produced until this point of the process are the result of an overfitting or whether they are the result of a robust trading strategy, capable of producing returns in the real trading at par of those that emerged from the early stages of the development process of the strategy. If the returns of the strategy are affected by overfitting and a lack of robustness in the application on out-of-sample data, you must go back to planning stage and re-evaluate the whole strategy. By contrast, if the strategy overcomes this round of the verification process, then the next step is the trading in real-time.



Walk-Forward analysis (WFA) is the best technique for this step of the process, and in particular it considers the performance of a trading strategy, only and strictly, on the basis of post-optimization, or trading of non-sampling data. It is moreover the simulation as close as possible to the way a trader will use the strategy in the real trading.

At the end, the three basic questions to test a trading system are:

1. will the trading model make profits at the end of the optimization process?
2. to what extent?
3. how much the changing market conditions like trends, volatility and liquidity, will affect the trading performance?

6. Trading the strategy in real-time

Signals and stops are generated by computer on a period basis in accordance with the formulas and rules issued initially; the only thing left to do to ensure the best chance of success is to honor all the signals of the system without any exception. If the trading strategy was tested properly and are making real trading in accordance with expectations, then you can believe the results that it provides you. Be with the system and follow all signs.

7. Monitor the performance of trading and ensure that it is consistent with the performance resulting from historical simulation

In the case where a systematic trading strategy has been correctly designed and checked, it should continue to behave, in the real trading, in the same way in which it performed in the development process.

An alarm signal can be given when you are having profits in highly rates than expected or when it is believed that the losses during the application of the strategy are too many, not even considering that their frequency is perfectly in line with that of the performance profile of the strategy.

8. Improve and refine the trading strategy

Through time and different markets the strengths and weaknesses of the strategy surely come out, and it is at this point that you can intervene with some improvements which in turn must be checked before using the new strategy.

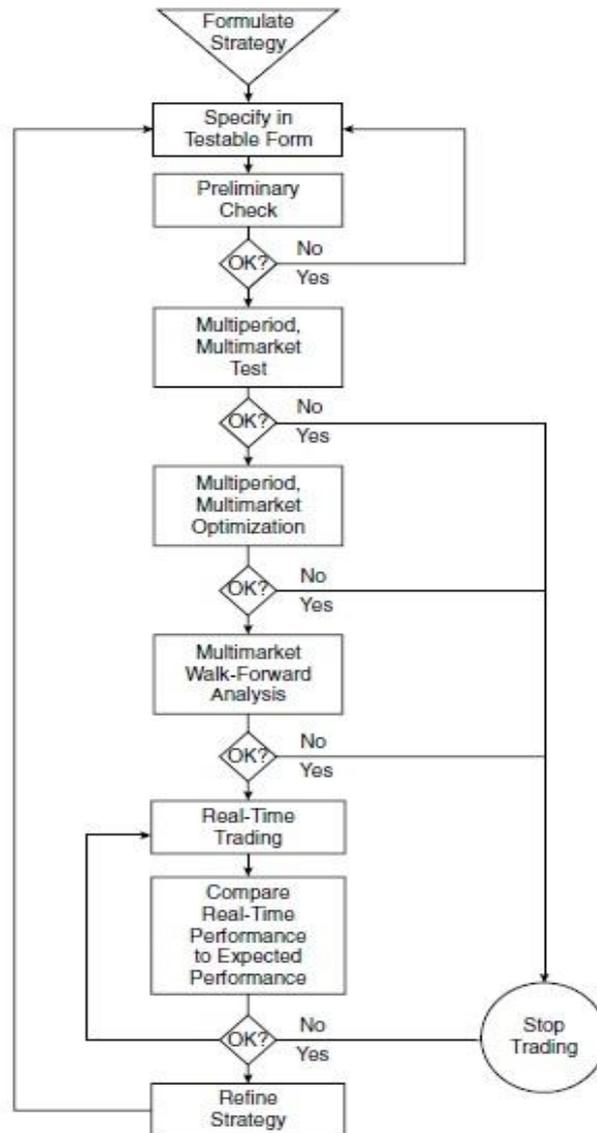


Figure 2.1: Scientific Approach to Trading Strategy Development according to Pardo¹⁴

2.4. THE ELEMENTS OF STRATEGY PLANNING

In a trading strategy we may consider three important elements which compose it.

2.4.1. Entry and exit

¹⁴ Robert Pardo, The evaluation and Optimization of Trading Strategies, p. 48

Robert Pardo (born 26 April 1951) is an American investor and author. He received his B.A. in History, Philosophy, and Sociology from Northwestern University.



Entries and exits are the engine of trading following a strategy. A trading strategy may involve more than one mechanism of entry and exit each time and sometimes the two can be completely uncorrelated. There are no limits to the variety of entries and exits.

Entry strategies can be of several types: an entry can be at market (or best), limit price or conditional price (also called stop orders), they can be enriched with parameters about the quantity (all or nothing, visible quantity) and given of specific time validity as well (good till cancelled or valid till date). Once an order has been executed, this is now regarded as a transaction or open position. When a trader has an open position, the resulting profit or loss depends on the fluctuation in the price. When a trader decides to close the open position to take a profit or a loss, if he gains in a long position we appreciate the way (going on) in value compared to the start position, or lose if it depreciates (goes down). In a short position it is the opposite.

As we need to define a scientific entry, stop loss and money management strategy, so it is necessary to define a scientific exit strategy. Also exit strategies could be of different types: we can set a target profit equal to some number of times the expected risk, or the strategy can be based on a partial target profit combined with a partial dynamic profit management, which is the application of dynamic stop profit levels which follow the price (also called dynamic profit management).

The best profit strategy is often strictly related to the entry strategy.

2.4.2. Risk management

All trading strategies are affected by various forms of risk because all of them are destined to undergo loss operations. Best trading strategies are those that employ a clear system of managing these risks. These systems are useful to reduce and limit the risk within established limits.

We are going to take care of three central issues for the scientific investment process: how to define the money to invest in each trade, how to decide what to do if things go wrong, and how to decide what to do if things go well. We have to manage these issues all together because they are strictly linked together and interdependent.

To make concepts clearer we consider a specific situation: let's assume we are willing to invest on a stock, following the indications coming from the crossings between a moving average and the price. Now suppose a golden cross shows up: time to buy! A series of questions should now arise – among all what should we do if the trade moves unfavorably – even if to find an answer is not an easy task. The scientific approach here is inevitable. This means that it is not possible to define and optimize a systematic trading strategy without the aid of a computer, since we need to analyze deeply all the alternatives on a historical data series in order to give an answer to all the questions expressed before.

Pardo distinguishes three categories of risk for which he gives the following definitions:

- *trade risk*: “The possibility of financial loss from an individual market position.”
- *strategy risk*: “The possibility of financial loss from the use of a trading strategy.”



- *portfolio risk*: "The possibility of financial loss at the portfolio level (potentially multi strategy, multiple time frame and multimarket) from the sum total of all trading therein."¹⁵

Technically speaking, to close a trade with a loss is called stop loss, that is, cutting the loss.

Unfortunately there are not unique rules to manage losses, because a stop loss can be defined in different ways: for example, on a point basis, 1€ below the entry price, or on a percentage basis, 3% below the entry price. Other techniques refer to some important prices on a chart; an example: if last price gets below the minimum of the past 20 days, then abandon the position. The best stop loss technique may not be the same for any strategy: usually it is not, since usually the best stop loss practice is a function of the specific strategy, the specific market, the specific timeframe, and so on.

2.4.3. Money management (or position sizing)

Ask what money management is means deciding how much capital I need to trade a strategy, and how much money I should invest in a single trade.

The money management issue belongs to the complex discipline of the asset allocation, that is, the best allocation of one's funds between all the alternative investments. A good asset allocation policy involves not only the weighting of choices to take in terms of investment vehicles, but also in terms of the amount of capital to allocate to each single trade and for this reason it is called *position sizing*. If our trading strategy tells us to buy shares of a listed stock, then, we first need to decide how much capital to invest, that is, how many shares we have to buy. It is not a decision that can be taken at random.

Depending on the capital amount invested in a single trade, we can get an idea of the total capital needed, given the fact at any time there could be several opened trades. The need for money is then variable. The needed capital depends then both on the amount invested per trade and the maximum number of simultaneous trades that might be in place at some time, but also depends on other issues as the stop loss policy.

2.4.4. An example applied to a graph

A crucial series of information comes from the equity line chart, that is, the cumulative chart of profits and losses of the trading strategy. It is not just a matter of **where** we get, but also **how** we get there.

Indeed the equity line chart gives us an immediate view on the level of pain we have to be prepared to suffer following the systematic trading strategy.

¹⁵ Robert Pardo, The evaluation and Optimization of Trading Strategies, p. 79

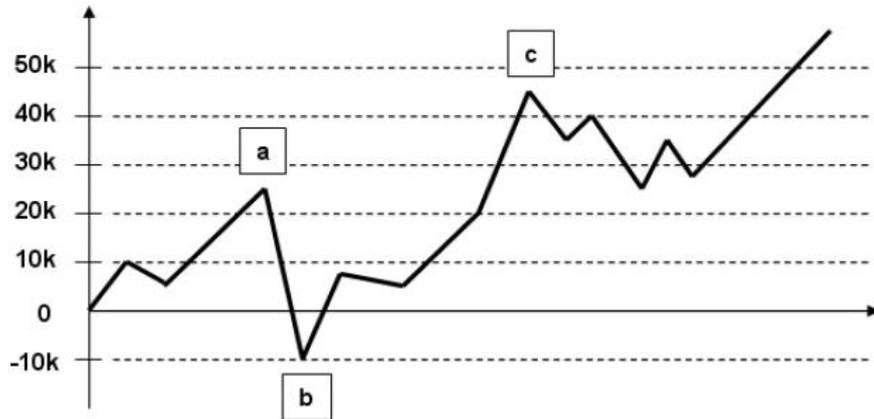


Figure 2.2: Example, not real, of an equity line chart

On the horizontal axis there are the trades, sorted chronologically, on the vertical axis there is the cumulated profit or loss, in thousands (k) Euro. Notice that the equity line originates in the point 0. The cumulated profit or loss does not consider the initial equity in this picture.

Let's now assume the initial equity is 30k Euro, like on next slide. The equity line is identical in shape and the final result will be:

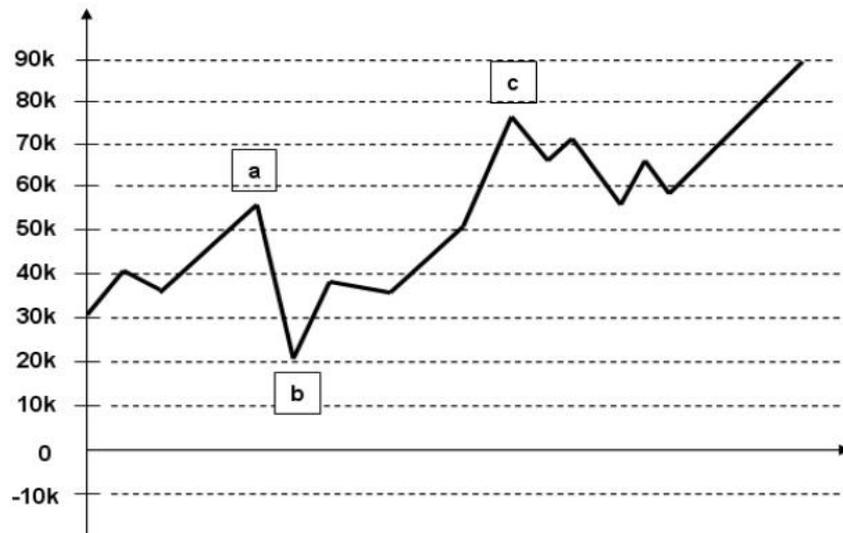


Figure 2.3: How the line moves with an initial capital of 30k

The most important data is not the shape of the line but how much the most negative phase of the equity line, the drop from *a* to *b*, affects the available capital, and, much more important, on the possibility for the trader to keep investing after such a loss. The maximum historical loss does not need to be sequential: it is simply the maximum cumulated drop between two consecutive relative ascending maximums on the equity line and it is called maximum historical drawdown (in the figure 2.3 we have this situation between point *a* and point *b*).



To choose the minimum need for capital to follow that strategy since its inception we have to consider the amount that after the growth of the equity line to the point a and the following drop to the point b leaves the investor with a capital higher than zero, so that he can keep investing. To be safe, then, the maximum historical drawdown (plus 1€, ideally) is the minimum money requirement to follow the strategy.

Two problems can arise after: the maximum historical drawdown is an indication of the maximum historical level of pain, but it does not give us any certainty about the future maximum level of pain. Some studies about money management have concluded that, for precautionary reasons, it is better to double the maximum historical drawdown to get to a good estimate of the money needed to follow a systematic strategy. The second issue, much more meaningful, is that the shape of the equity line, and the value of the maximum historical drawdown as a consequence, depend not only from the strategy used, but from the money invested in each single trade as well. To solve this issue we need to proceed by trials and errors: we define arbitrarily an amount of money per trade, test the strategy on historical data and determine a maximum drawdown. Then we double that value to get to a precautionary estimate of the minimum need for money. If that value exceeds the really available money, we need to restart from the beginning, reducing the capital per trade.

A further complication comes from the possibility that the strategy is applied to more than one asset: in such a situation it could happen to have more than one trade opened at the same time. Investing 1k euro per trade on a system that operates on a single instrument means to always use at most 1k euro; but if the system operates on a portfolio of instruments, then we need to know how many of them we could be invested on at the same time, because the number of simultaneous trades rises the need for money. So, at the end, to obtain a good estimation of the minimum needed capital to be sure to be always able to follow the strategy, we have to add up the total amount of capital needed to face the maximum potential number of simultaneous trades to the double of the maximum historical drawdown.

Again, if this value exceeds the real available capital, we need to restart from the beginning, reducing the capital invested per trade.

Exit strategies can have a different impact on the shape of the equity line, on the total profit, and on the maximum historical drawdown as well.

2.4.5. Operations that can be made on the market

After the global financial crisis started in the year 2008, a new term has spread: financial leverage.

The leverage is an accounting artifice that if on one side represents huge risks for the financial system (the crisis is the glowing proof) it also offers incredible advantages for investors, especially the very small ones.

The idea of the leverage is quite simple: if I have 10k euro on my account and my bank allows me to use a ten to one leverage, or 10:1, or 1000%, then I can invest up to 100k euro; in other words, I can open positions valued up to ten times the real money I have. This is a big opportunity: to double the capital owned can be a very hard task, but to make a 10% profit can be much easier. If the 10% profit is made on a capital 10 times higher than its real value, then the real capital doubles.



But, as in most things, there is also here the other side of the coin to which we must be careful: it is dramatically true also the opposite, in case of loss: the leverage works in the same way on both directions, amplifying profits if things go well, but losses as well if things go bad!

In spite of the financial crisis the leverage is still available for anyone who asks for it, but it is not free, nor for all. There are some conditions in its use: the client has to open a credit line, covered by proper real warranties. Moreover the leverage has some costs, given by the interest that needs to be paid on the implied money lending: if we invest money we do not have, someone is lending us that money, hence we have to pay interests. Those interests are usually equal to several percent points, on an annual basis of course, but with continuous compounding. The longer the duration of the leveraged investment, the higher the profit we need to get, then, otherwise the costs of the leverage can erase any profit.

Short selling (or just *short*), is an artifice made possible by the modern financial engineering and it is a way for “betting” on a downward movement instead on an upward one. When someone buys something it is said he his opening a long position; on the other direction there’s short selling, that is, opening a short position.

In order to understand how it is possible to sell short we first need to fully understand what it means: sell short means to sell something that does not belong to us. How can we do that? We need to borrow: if i want to sell a stock I do not have I can borrow it from another investor, sell it, wait for a while to see if the price drops, then buy it back, and finally retribute it.

The risk for the short seller is the opposite of that of the long buyer: when we buy a stock our risk is that the price might drop; when we sell short a stock our risk is the opposite, that is, that the price might increase. In all this process there are also some costs due to the need for accounting of some operations which makes the short selling possible. These costs are usually of two types: the first is a fixed money amount that has to be paid for the short selling practice, due to the lending operation; the second is a variable cost, given by the interests that need to be paid to the bank for the value of the stock sold. This because in short selling we collect money we could invest in risk-free assets, getting an extra profit on money that do not even belong to us.

The operations that can be made on the markets are four, then:

- 1) *to open a new long*: to buy something under the expectation of a growth in price;
- 2) *to sell to close*: to sell in order to close a long position;
- 3) *to sell short*: to sell something short under the expectation of price drop;
- 4) *to buy to cover*: to buy in order to close a short position.

Who buys can be either an investor who is flat (no opened positions yet) and is opening a new long position, or one who covers a short position previously opened (cases 1 and 4).

Who sells can be either someone who is closing a long position previously opened, or someone who is flat and is opening a new short position (cases 2 and 3).



2.5. COMPARING DIFFERENT TRADING SYSTEM

A systemic strategy can be managed in three different ways:

- *manually*: when manifests an operating signal the trader must provide personally to carry out the operation concerned and this is defined discretionary trading. It is based on the experience, the intuition and the judgment of traders regarding how to open or close a position. Trading activity so performed is never equal to itself, rules and variables may also change from time to time;
- *automatically*: programming a computer because when a certain set of operating conditions shows up it automatically buys or sells one or more financial instruments and this is called automatic trading, or algorithmic. Analysis and evaluations are carried out before the operational phase. The translation of signals in orders, from the computer itself, also prevents the emotions can influence even on this stage of the process. Here it is also tested the strategy through historical data with the use of special programs and then generate a system report that lists all the parameters useful for the evaluation of the goodness of the strategy itself. It is based on the signals that derive from systems based entirely on technical analysis or systems which read the news or financial statement data showed in Bloomberg platform, although applicable in several ways.
- *systematic*: is a mix between the completely manually and the automatically. We have it when the strategy is codified and give us a signal when it is time to buy or sell following the given instructions but it is the trader who manually implements the operation of buying or selling.

How to choose one of the two techniques? We try to find the points in favor and against each of them.

DISCRETIONARY TRADING	SYSTEMATIC TRADING	AUTOMATIC TRADING
advantages		
<ul style="list-style-type: none"> ○ It easily adapts to market conditions. ○ Trading decisions are based on experience. ○ Traders learn to understand what signals have greater chance of success. ○ It is able to use a large amount of information. 	<ul style="list-style-type: none"> ○ It takes into account the importance of a risk management. ○ The strategy can usually be tested on historical data ○ It helps to avoid emotional decision 	<ul style="list-style-type: none"> ○ It offers a wide range of back testing. ○ It has strict rules: the trade there, or not. ○ Traders who rely on mechanical systems are less prone to emotional stress than to discretionary trading.



disadvantages		
<ul style="list-style-type: none">○ They cannot be automated because there is always a decision to be taken by the trader.○ It takes time and patience to develop the necessary experience to launch trade success and take notes on a discretionary basis.	<ul style="list-style-type: none">○ It exists the risk of selecting a trading system that is poorly designed, or based on unrealistic assumption, or using inadequate risk controls.	<ul style="list-style-type: none">○ Many traders refer to systems insufficiently tested.○ The Forex market is constantly changing. All markets, including Forex, are based on an element of unpredictability: the conditions can be very similar, but they are never really the same.○ A system that has worked well in the past, does not necessarily work in the future too.

Before choosing whether to use, there are some very important points to consider:

- Make sure that the system adopted reflect our personality;
- In trading there is always a need for rules and more importantly is consistently adhere to them;
- Taking the time to choose the most suitable system.
- Before you start to follow a trading system it is crucial to test it at least with a FOREX demo. All brokers will provide one.

2.6. BACKTESTING

Backtesting functionality in MultiCharts, as in all other trading platforms, allows testing on historical data a particular strategy in order to evaluate the goodness and the opportunity to use it with a real account, considering the various types of reports and information that the development software of the strategy is able to produce.

The reporting activity typically includes a summary of the performance, which provides a multitude of statistical measures. This includes some essential values as the total net profit, maximum drawdown, the number of operations, the percentage of winning trades, the average profit of the winning trades, the average loss of losing trades, and the average profit of all transactions. These values are also presented divided by upside and the downside operations.

It will be discussed afterwards the study of strategy performance reports and values included in it along with the study of equity lines' graphs.

Equity line is the graph of the profits generated by the trading system. If the report tells us what we have gained, the equity line appears immediately as we have gained and is one of the best tools to immediately evaluate the consistency and reliability of the



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system. The interpretation is straightforward and easy: it evaluates the consistency to produce profits by seeking harmony in the equity line. The detailed equity line returns to the trader the size of the real risk of each single trade, showing exactly what would really have faced in the market.



CHAPTER 3: THE CORE OF THE PROJECT

3.1. THE AIM OF THE WORK

After seeing all the basic theory to trading, with the use of MultiCharts program, I created a coding system of trading to do back test on historical data in order to verify the consideration: "If you look out for divergences when trading, you have probably seen some situations that show neither convergent behavior nor reflect a divergent development in the classical sense of the word. Quite possibly, this was a hidden divergence."¹⁶

The strategy is based on (see the footnote) how to find these particular situations, in a chart, between the price of an index in the market and a particular indicator, which in this case is the Chaikin Oscillator (CHO indicator).

This indicator (see the appendix for the code) is built as the difference between the 3-days exponential moving average and the 10-days exponential moving average of the Accumulation/Distribution indicator.

Speaking again of the article, first of all, the author clarifies the meaning of hidden divergences and he says: "Divergences are differences between the development of the underlying and the indicator. Depending on their extent, these differences are of a bullish (price forms a lower low than the previous relative one, but indicator forms a higher low) or bearish nature (price forms a higher high, but indicator forms a lower high). These classic divergences suggest that the current trend movement could come to an end and a trend reversal might be imminent. Besides such obvious divergences, there are also hidden ones. These reaffirm the prevailing trend and indicate a good investing opportunity in the direction of the trend. They usually occur during minor corrective movements. According to George Lane, who made this kind of divergence public, these formations also suggest that an important high or a low is in the making that might trigger a larger correction or even a trend reversal. The following variations of hidden divergences can be distinguished:

Bullish Hidden Divergence (Bear Setup):

- price marks higher lows or double lows in the uptrend;
- indicator marks series of falling lows;
- buy signal of the indicator is a (final) opportunity for a long position.

¹⁶ Marco Baeger, *How to Detect Hidden Divergences*, "Traders", March 2012, pp. 54.

Mr Marco Baeger completed a three-year comprehensive training programme to qualify as a junior bank manager, and has been trading his own account since 2009 specialising in the trading of EUR/USD and the DAX via CFDs. His trading approach is based on the combination of price and volume data. He is a freelance writer as well.



Bearish Hidden Divergence (Bull Setup)

- price marks lower highs or double highs in the downtrend;
- indicator marks series of higher highs;
- sell signal of the indicator is a (final) opportunity for a short position “¹⁷”.

3.1.1. The choice of data

For my analysis, in the first place I chose a particular asset class, currencies (listed on the Forex market), because I wanted to avoid any influence of dividends and maturities. On the foreign exchange market (foreign currency exchange), known more commonly as Forex, or currency market, are currently traded pairs of currencies.¹⁸ For all of them I needed Open and Close prices, High and Low prices and Volumes of all days selected.

Unfortunately, data achievable from some providers do not have the Volume variable, necessary for the control of the strategy so I had to choose some indexes even if they are less liquid than Forex.

The indexes I picked out are:

- DOW JONES Industrial Average (^DJI) it is the main stock index quoted on the US markets, created by Charles Dow, father of technical analysis. It is a price-weighted index, including the top 30 stocks of Wall Street listed on the New York Stock Exchange;
- S&P500 (^GSPC) is a market-capitalization-weighted index developed by Standard and Poor's consisting of those stocks within the S&P 500 Index that exhibit strong value characteristics. The S&P 500/Citigroup Value Index uses a numerical ranking system based on four value factors and three growth factors to determine the constituents and their weightings;¹⁹
- NASDAQ Composite (^IXIC) is a market-capitalization weighted index including more than 3,000 common equities listed on the Nasdaq stock exchange. The types of securities in the index include American depositary receipts, common stocks, real estate investment trusts (REITs) and tracking stocks. The index includes all Nasdaq listed stocks that are not derivatives, preferred shares, funds, exchange-traded funds (ETFs) or debentures;²⁰
- FTSE100 (^FTSE) is a share index of the 100 most highly capitalized companies listed on the London Stock Exchange and it is similar to the Standard & Poor's in the United States;
- DAX30 (^JDAXI) is a stock index and it is the segment of the Frankfurt Stock Exchange that contains the 30 stocks of the largest and most liquid German companies with the highest capitalization;
- RUSSELL 2000 (^RUT) is an index measuring the performance approximately 2,000 small-cap companies in the Russell 3000 Index, which is made up of 3,000

¹⁷ Marco Baeger, *How to Detect Hidden Divergences*, “Traders”, March 2012, pp. 55.

¹⁸ <http://www.zonegroupfx.com/forex.php>

¹⁹ Definition taken from: <http://www.investopedia.com/terms/s/sp500-value.asp>

²⁰ Definition taken from: <http://www.investopedia.com/terms/n/nasdaqcompositeindex.asp>



of the biggest U.S. stocks. The Russell 2000 serves as a benchmark for small-cap stocks in the United States.

All the data²¹ considered are daily and in a timeframe of 10 years, from the 1st January 2005 to the 31st August 2015 so I had an adequate number of observations on which apply the strategy. They are plotted in MultiCharts with a bar chart.

3.1.2. The creation of the codes

I initially created a simplified code (see the appendix: Signal based on minimum and maximum to 20 days) which computes the Chaikin Oscillator for all the data selected and then, following two conditions, the indicator is compared with the highest or lowest price of an interval over the last 20 days. In particular, the first condition is for the bearish situation while the second is for the bullish one. If the conditions, considered separately, are true in the bar chart appears signal of buy (blue) or sell (red) respectively for the condition which is verified and the day after the signal it is suggested to compute the order at the closing price of the day before. This is also called entry strategy.

Regarding the exit strategy I decided to put a stop loss over the second maximum, once the position was opened and a target once a risk, but these two parameters are self-excluding.

The full strategy is tested in all the indexes considered.

After that, I created also a more complex strategy (see the appendix for the code) which computes again the Chaikin Oscillator for all the data selected but this time the indicator is compared with an array, specially created, in which I distinguished two cases:

- Bearish:
it is formed by two maximum and a minimum which are preceded and followed from two lower maximums and two lower minimums, respectively.
- Bullish:
it is formed by two minimum and a maximum which are preceded and followed from two lower minimums and two lower maximums, respectively.

Also here, if the two conditions, comparing the indicator with the array, are separately true it is possible to open a position buying or selling at the closing price of the day before as suggested by the signal.

Regarding the exit strategy and the target, I used the same parameters of the previous code.

The second full strategy, as well, is tested in all the indexes considered.

3.2. TESTING THE STRATEGY

In the analysis of the historical data, I applied both the strategies, but I decided to present the results only of the second more complex based on the array because I obtained the same conclusions from both of them.

²¹ They were taken from Yahoo Finance: <https://it.finance.yahoo.com/>

3.2.1. DOW JONES Industrial Average

I start to plot in MultiCharts the data of Dow Jones index and insert the Chaikin indicator (in the bottom part of the figure 3.1), then I insert the Chaikin signal in order to obtain the sell and buy signals in the graph of the price (the main window in the figure). In this way, I find all the point in which, according to the conditions of the code, there is the presences of the divergences.

The dotted lines, which connect the different point represented, indicate the profitable (green) and unprofitable (red) situations before the next state of divergence.



Figure 3.1: Bar chart for Dow Jones Industrial Average with the application of the trading strategy

In the figure 3.2, instead, it is more comprehensible how the divergence situation is found: in the highlighted part it is possible to see the triangle figure necessary to identify the aim of my research. In this case, we are in a bullish moment: point A is the first minimum, point B is the maximum and point C is the second minimum and in the bar chart of prices point A is greater than point C, exactly the contrary of the situation in the Chaikin Oscillator line where point A is lower than point C. This represents precisely a divergence.

The signal suggests us to buy because an upward trend is expected, but in reality only after an initial suffer, where the price decrease, we have that the price increase allowing us to gain from the transaction previously made in the market. As the green dotted line indicates, this was a profitable moment.



Figure 3.2: How to read a divergence in a detailed study of Dow Jones index

After a global analysis of the chart, I studied both the equity line and the strategy performance report.

Equity Curve Detailed

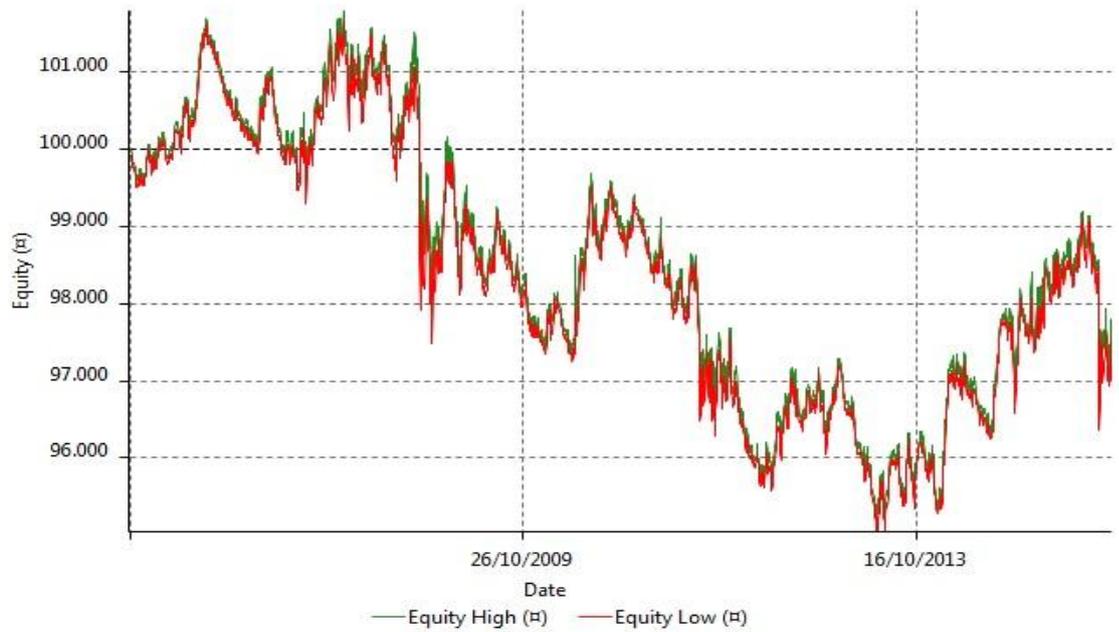


Figure 3.3: Equity line for Dow Jones index



As is possible to see in the tables below, the values provide by the report are many and also divided by all trades, long trades and short trades so we can know which of the last two are doing better in the market. While all statistics are important, it is useful to limit the scope of five key performance metrics: Net Profit, Profit Factor, Percent Profitable, Return on Account and Maximum Strategy Drawdown.

Strategy Performance Summary			
	All Trades	Long Trades	Short Trades
Net Profit	(=1215,16)	=3050,89	(=4266,05)
Gross Profit	=12321,44	=7922,04	=4399,4
Gross Loss	(=13536,6)	(=4871,15)	(=8665,45)
Adjusted Net Profit	(=6154,75)	(=626,73)	(=7608,2)
Adjusted Gross Profit	=10267,87	=6233,06	=3223,61
Adjusted Gross Loss	(=16422,61)	(=6859,79)	(=10831,81)
Select Net Profit	(=731,37)	=3018,84	(=3750,21)
Select Gross Profit	=8243,95	=5859,82	=2384,13
Select Gross Loss	(=8975,32)	(=2840,98)	(=6134,34)
Account Size Required	=6144,76	=3909,45	=5571,35
Return on Account	(19,78%)	78,04%	(76,57%)
Return on Initial Capital	(1,22%)	3,05%	(4,27%)
Max Strategy Drawdown	(=6743,33)	(=5444,62)	(=6766,15)
Max Strategy Drawdown (%)	(6,62%)	(5,31%)	(6,68%)
Max Close To Close Drawdown	(=6144,76)	(=3909,45)	(=5571,35)
Max Close To Close Drawdown (%)	(6,04%)	(3,83%)	(5,51%)
Return on Max Strategy Drawdown	(0,18)	0,56	(0,63)
Profit Factor	(0,91)	1,63	(0,51)
Adjusted Profit Factor	(0,63)	(0,91)	(0,3)
Select Profit Factor	(0,92)	2,06	(0,39)
Max # Contracts Held	1	1	1
Slippage Paid	=0	=0	=0
Commission Paid	=0	=0	=0
Open Position P/L	(=1011)	(=1011)	n/a
Annual Rate of Return	(0,12%)	0,31%	(0,43%)
Monthly Rate of Return	(0,01%)	0,03%	(0,04%)
Buy Hold Return	=60225,83	=56355,51	=60225,83
Avg Monthly Return	(=18,55)		
Monthly Return StdDev	=451,58		

Table 3.4: Strategy performance Summary for Dow Jones index

Total Trade Analysis			
	All Trades	Long Trades	Short Trades
Total # of Trades	59	29	30
Total # of Open Trades	1	1	0
Number Winning Trades	36	22	14
Number Losing Trades	22	6	16
Percent Profitable	61,02%	75,86%	46,67%
Avg Trade (win loss)	(=20,6)	=105,2	(=142,2)
Average Winning Trade	=342,26	=360,09	=314,24
Average Losing Trade	(=615,3)	(=811,86)	(=541,59)
Ratio Avg Win / Avg Loss	(0,56)	(0,44)	(0,58)
Largest Winning Trade	=801,98	=763,51	=801,98
Largest Losing Trade	(=2030,17)	(=2030,17)	(=1311,98)

Table 3.5: Total trade analysis for Dow Jones index



From the detailed equity line (see fig. 3.3) it is possible to see that the strategy does not produce any profits or just for a limited period of time and for the majority of the timeframe considered it only produces losses for the investor. The same information is confirmed in the values of Net Profit (-1215.16) which is negative considering all trades and positive (3050.89) only for the long trades.

In the following table are summarized the five key elements (taken from the table 3.1 and 3.2), which are to be considered all together, to judge a trading strategy. I put different colors in the values to better underling the difference between positive (black) and negative ones (red):

	All trades	Long trades	Short trades
Total Net Profit	(1215.16)	3050.89	(4266.05)
Profit Factor	(0.91)	1.63	(0.51)
Percent Profitable	61.02%	75.86%	46.67%
Return on Account	(19.78%)	78.04%	(76.57%)
Maximum Drawdown	(6743.33)	(5444.62)	(6766.15)

Profit factor is defined as the gross profit divided by the absolute value of the gross loss (including commissions) for the entire trading period. This performance metric relates the amount of profit per unit of risk, with values greater than one indicating a profitable system.²²

The good (in general better in greater than 1.3 or 1.4) and positive value for long trades means that the system produces a profit, but the negative values for the short and above all the all trades show that the strategy is producing losses.

Percent profitable is better known as the probability of winning. It is calculated by dividing the number of winning trades by the total number of trades generated by the strategy for a specified period. For Dow Jones index, this value is appreciable in the first two column because greater than 50%.

Return on Account is the expectancy of the system: it represents the average amount of money that was gained or lost per trade. The average trade net profit is calculated by dividing the total net profit by the total number of trades.²³

The negative percentage of money, in this case loses because the negative related value, is due to the negative value of Net Profit.

The maximum drawdown metric refers to the "worst case scenario" for a trading period. It measures the greatest distance, or loss, between two consecutive equity peaks. This metric can help measure the amount of risk incurred by a system and determine if a system is practical based on account size. If the largest amount of money that a trader is willing to risk is less than the maximum drawdown, the trading system is not suitable for

²² Definition taken from: <http://www.investopedia.com/articles/fundamental-analysis/10/strategy-performance-reports.asp>

²³ Definition taken from: <http://www.investopedia.com/articles/fundamental-analysis/10/strategy-performance-reports.asp>



the trader. A different system, with a smaller maximum drawdown, should be developed.²⁴

In this particular case we are in the first case, where the largest amount of money that a trader is willing to risk is less than the maximum drawdown, so it is possible to conclude that the trading system for Down Jones is not profitable, also because four of the five basic metrics are negative: a good signal to avoid to lose money.

This result was in a way anticipated by numerous red lines of unprofitable situations in the bar chart of the index.

I repeated the same studies for the NASDAQ index and the other following indexes, in order to better test the trading strategy under analysis and control if it is good or, only for some particular cases, as for the Dow Jones, it does not work well.

3.2.2. NASDAQ Composite

From a general point of view of figure 3.4, we can notice that in NASDAQ index there is a strong presence of differences but also a lot of red dotted line which can anticipate us the possible unsuccessful result we can find after the analysis of the equity line and the report.



Figure 3.4: Bar chart for NASDAQ Composite with the application of the trading strategy

Starting from the equity line, I obtained this following chart:

²⁴ Definition taken from: <http://www.investopedia.com/articles/fundamental-analysis/10/strategy-performance-reports.asp>



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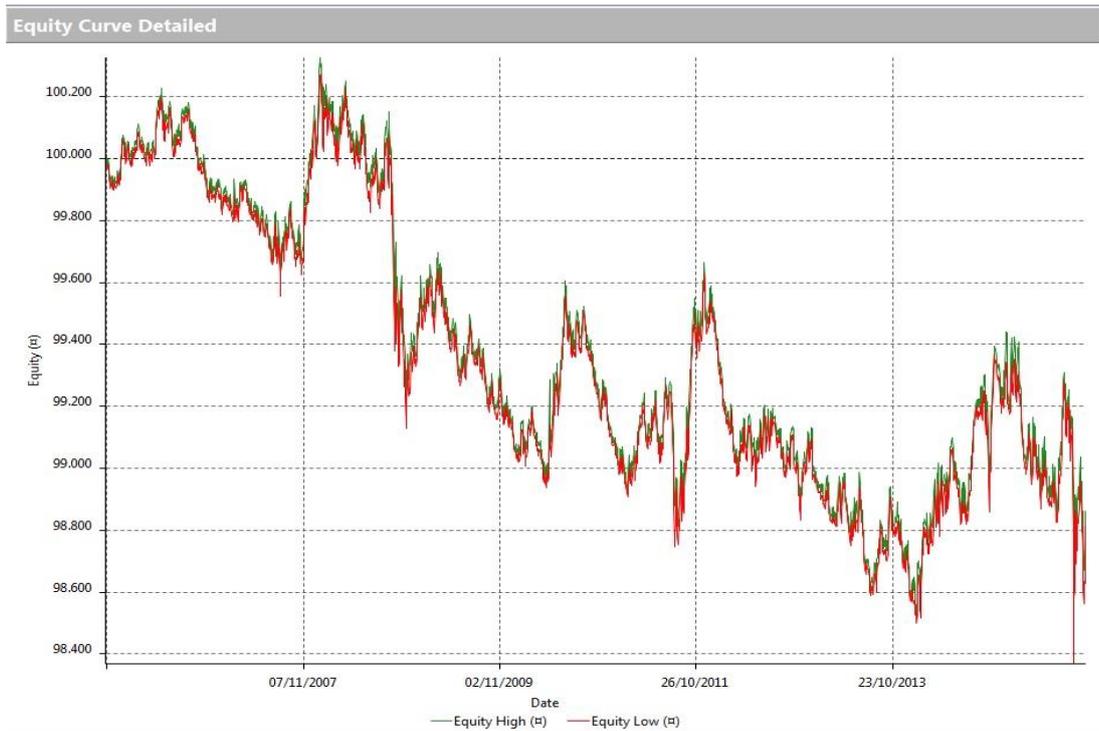


Figure 3.5: Equity line for NASDAQ Composite index

As in the case of Dow Jones index, there are lots of picks and the equity high and equity long curves are coincident, but a general downward trend, with the possibility to lose money, comes out.

The same conclusion may be repeated analyzing the five key elements: the majority of them are negative, both in all trades and in short trades, and indicate a bad direction of the general strategy. Only long trades have four over five positive parameters. This makes me to say that the full strategy is not appreciable for the all trades but can be considered in case of long trades.



Strategy Performance Summary			
	All Trades	Long Trades	Short Trades
Net Profit	(=967,17)	=907,02	(=1874,19)
Gross Profit	=3282,56	=1952,95	=1329,61
Gross Loss	(=4249,73)	(=1045,93)	(=3203,8)
Adjusted Net Profit	(=2474,82)	=63,66	(=3099,21)
Adjusted Gross Profit	=2702,28	=1504,91	=960,84
Adjusted Gross Loss	(=5177,1)	(=1441,25)	(=4060,05)
Select Net Profit	(=630,65)	=874,87	(=1505,52)
Select Gross Profit	=2178,96	=1303,18	=875,78
Select Gross Loss	(=2809,61)	(=428,31)	(=2381,3)
Account Size Required	=1626,25	=825,19	=2047,08
Return on Account	(59,47%)	109,92%	(91,55%)
Return on Initial Capital	(0,97%)	0,91%	(1,87%)
Max Strategy Drawdown	(=1956,87)	(=1201,88)	(=2294,58)
Max Strategy Drawdown (%)	(1,95%)	(1,2%)	(2,29%)
Max Close To Close Drawdown	(=1626,25)	(=825,19)	(=2047,08)
Max Close To Close Drawdown (%)	(1,62%)	(0,82%)	(2,04%)
Return on Max Strategy Drawdown	(0,49)	0,75	(0,82)
Profit Factor	(0,77)	1,87	(0,42)
Adjusted Profit Factor	(0,52)	1,04	(0,24)
Select Profit Factor	(0,78)	3,04	(0,37)
Max # Contracts Held	1	1	1
Slippage Paid	=0	=0	=0
Commission Paid	=0	=0	=0
Open Position P/L	(=174,97)	(=174,97)	n/a
Annual Rate of Return	(0,1%)	0,09%	(0,19%)
Monthly Rate of Return	(0,01%)	0,01%	(0,02%)
Buy Hold Return	=119826,02	=115709,24	=119826,02
Avg Monthly Return	(=9,52)		
Monthly Return StdDev	=123,72		

Table 3.3: Strategy Performance Summary for NASDAQ Composite index

Total Trade Analysis			
	All Trades	Long Trades	Short Trades
Total # of Trades	53	26	27
Total # of Open Trades	1	1	0
Number Winning Trades	32	19	13
Number Losing Trades	21	7	14
Percent Profitable	60,38%	73,08%	48,15%
Avg Trade (win loss)	(=18,25)	=34,89	(=69,41)
Average Winning Trade	=102,58	=102,79	=102,28
Average Losing Trade	(=202,37)	(=149,42)	(=228,84)
Ratio Avg Win / Avg Loss	(0,51)	(0,69)	(0,45)
Largest Winning Trade	=251,14	=245	=251,14
Largest Losing Trade	(=617,62)	(=617,62)	(=458,24)

Table 3.4: Total Trade Analysis for NASDAQ Composite index

Summary table with the five parameters of reference:

	All trades	Long trades	Short trades
Total Net Profit	(967.17)	907.02	(1847.19)
Profit Factor	(0.77)	1.87	(0.42)
Percent Profitable	60.38%	73.08%	48.15%
Return on Account	(59.47%)	109.92%	(91.55%)

Maximum Drawdown	(1956.87)	(1201.88)	(2294.58)
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3.2.3. S&P500

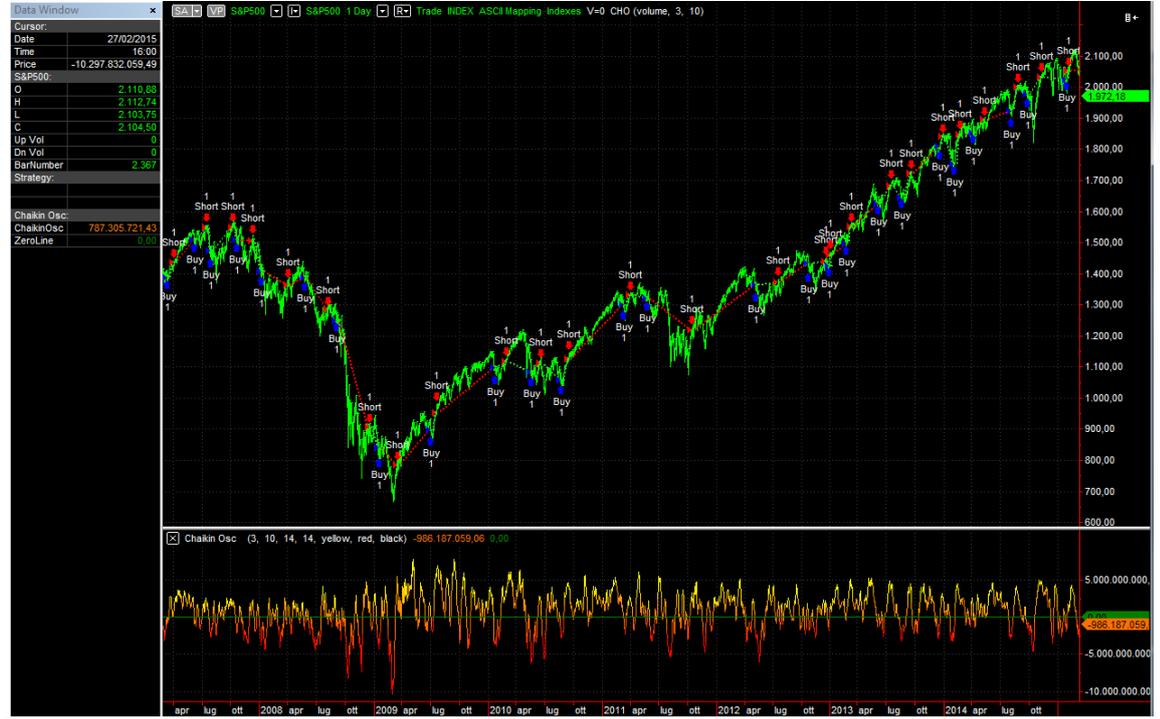


Figure 3.6: Bar chart for S&P500 with the application of the trading strategy

As in the previous indexes, after including the Chaikin signal in the bar chart of price movements for S&P500 index, the outcome is a full main window with signals of buy or sell. The red dotted lines are balanced by the green ones.

Next step is to focus the attention in the detailed equity line chart and in the important values of the report.

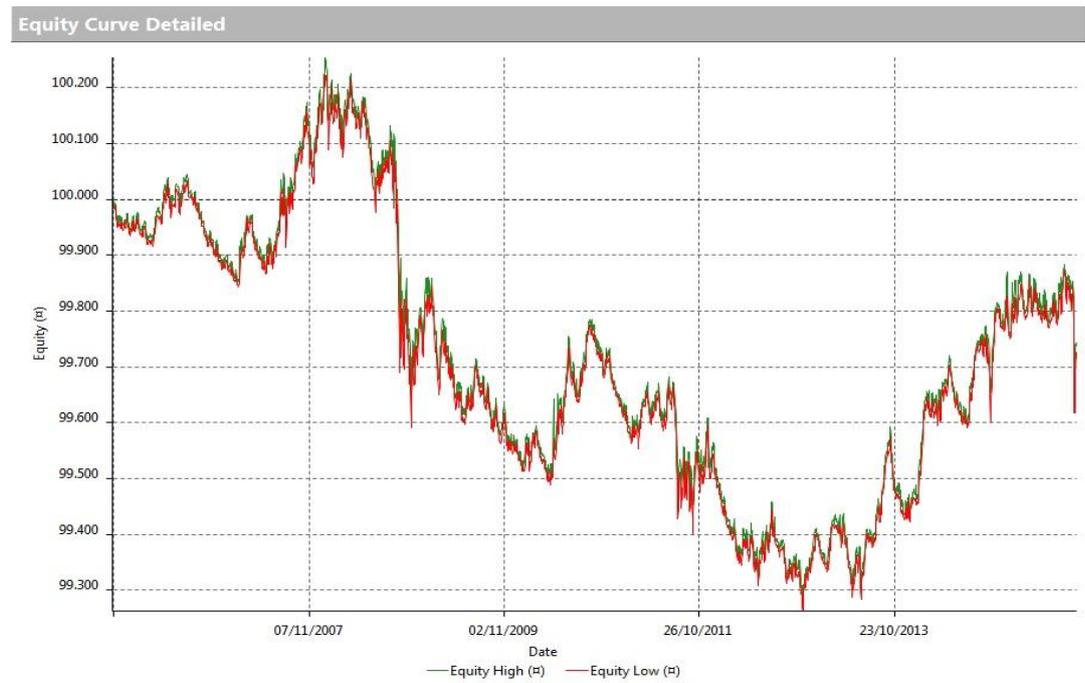


Figure 3.7: Equity line for S&P500 index

In the detailed equity curve of figure 3.7, there are lots of picks and the equity high and equity long curves are coincident.

You may notice a general downtrend in particular from November 2007 to the year 2012, but, approximately, since October 2012 it seems to start a trend reversal which can push to think in a positive result from the study of the parameters.

This hypothesis is not confirmed for the all trades because the majority of the elements of the report (see tables 3.5 and 3.6) are negative, as the previous cases.

Again this time, however, it is not possible say the same of long trades: for it the key parameters suggests an appropriate strategy.



Strategy Performance Summary			
	All Trades	Long Trades	Short Trades
Net Profit	(172,55)	342,23	(514,78)
Gross Profit	1618,2	986,47	631,73
Gross Loss	(1790,75)	(644,24)	(1146,51)
Adjusted Net Profit	(820,37)	(126,47)	(970,24)
Adjusted Gross Profit	1352,17	780,78	462,89
Adjusted Gross Loss	(2172,54)	(907,25)	(1433,14)
Select Net Profit	(310,87)	291,72	(602,59)
Select Gross Profit	961,74	592,44	369,3
Select Gross Loss	(1272,61)	(300,72)	(971,89)
Account Size Required	876,59	543,99	681,29
Return on Account	(19,68%)	62,91%	(75,56%)
Return on Initial Capital	(0,17%)	0,34%	(0,51%)
Max Strategy Drawdown	(990,67)	(705,24)	(727,65)
Max Strategy Drawdown (%)	(0,99%)	(0,7%)	(0,73%)
Max Close To Close Drawdown	(876,59)	(543,99)	(681,29)
Max Close To Close Drawdown (%)	(0,87%)	(0,54%)	(0,68%)
Return on Max Strategy Drawdown	(0,17)	0,49	(0,71)
Profit Factor	(0,9)	1,53	(0,55)
Adjusted Profit Factor	(0,62)	(0,86)	(0,32)
Select Profit Factor	(0,76)	1,97	(0,38)
Max # Contracts Held	1	1	1
Slippage Paid	0	0	0
Commission Paid	0	0	0
Open Position P/L	(105,48)	(105,48)	n/a
Annual Rate of Return	(0,02%)	0,03%	(0,05%)
Monthly Rate of Return	0%	0%	0%
Buy Hold Return	61568,02	55436,63	61568,02
Avg Monthly Return	(2,36)		
Monthly Return StdDev	52,59		

Table 3.5: Strategy Performance Summary for S&P500 index

Total Trade Analysis			
	All Trades	Long Trades	Short Trades
Total # of Trades	59	29	30
Total # of Open Trades	1	1	0
Number Winning Trades	37	23	14
Number Losing Trades	22	6	16
Percent Profitable	62,71%	79,31%	46,67%
Avg Trade (win loss)	(2,92)	11,8	(17,16)
Average Winning Trade	43,74	42,89	45,12
Average Losing Trade	(81,4)	(107,37)	(71,66)
Ratio Avg Win / Avg Loss	(0,54)	(0,4)	(0,63)
Largest Winning Trade	98,33	94,51	98,33
Largest Losing Trade	(343,52)	(343,52)	(174,62)

Table 3.6: Total Trade Analysis for S&P500 index

Summary table with the five parameters of reference:

	All trades	Long trades	Short trades
Total Net Profit	(172.55)	342.23	(514.78)
Profit Factor	(0.9)	1.53	(0.55)
Percent Profitable	62.71%	79.31%	46.67%
Return on Account	(19.68%)	62.91%	(75.56%)

Maximum Drawdown	(990.67)	(705.24)	(727.65)
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3.2.4. DAX

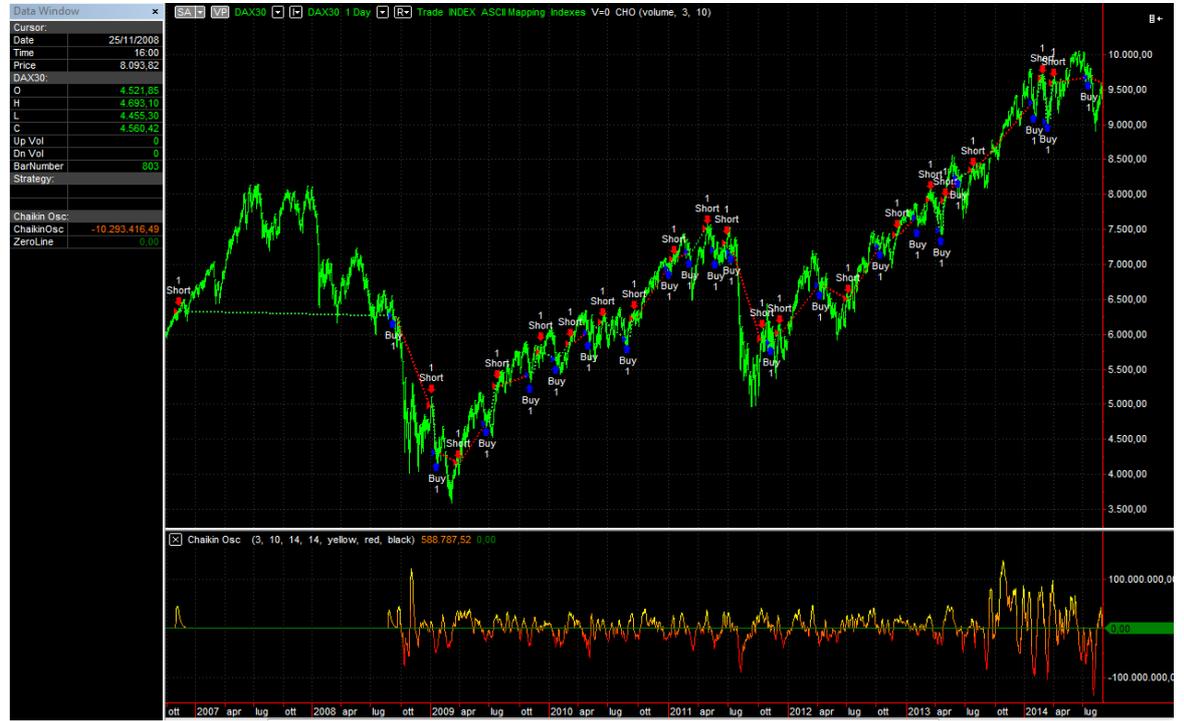


Figure 3.8: Bar chart for DAX with the application of the trading strategy

In this bar chart the DAX index is plotted. Immediately, a difference in the below part can be notice: till August 2008 the Chaikin indicator is equal to zero due to the absence of the Volume variable in the data. After that period it normally fluctuates along the zero line. And the presence of signals are more constant.

Also the equity line is different from before: it is more balance in increasing and decreasing movements even if sometimes there are some “anomalous” picks.

Other differences come out from the study of the report.

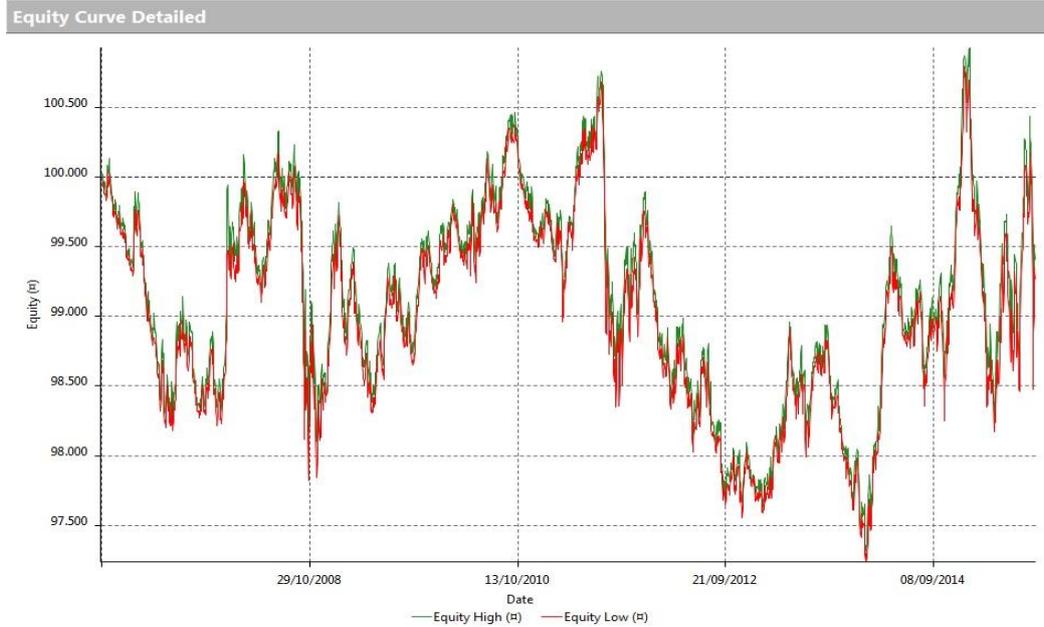


Figure 3.9: Equity line for DAX index

Strategy Performance Summary

	All Trades	Long Trades	Short Trades
Net Profit	€231,96	€2499,47	(€2267,51)
Gross Profit	€9496,44	€5454,65	€4041,79
Gross Loss	(€9264,48)	(€2955,18)	(€6309,3)
Adjusted Net Profit	(€3748,81)	(€107,8)	(€5255,61)
Adjusted Gross Profit	€7762,64	€4168,98	€2875,03
Adjusted Gross Loss	(€11511,45)	(€4276,78)	(€8130,64)
Select Net Profit	€172,89	€3332,93	(€3160,04)
Select Gross Profit	€5346,19	€3763,81	€1582,38
Select Gross Loss	(€5173,3)	(€430,88)	(€4742,42)
Account Size Required	€2838,9	€1425,56	€3659,56
Return on Account	8,17%	175,33%	(61,96%)
Return on Initial Capital	0,23%	2,5%	(2,27%)
Max Strategy Drawdown	(€3525,51)	(€2417)	(€4860,75)
Max Strategy Drawdown (%)	(3,5%)	(2,4%)	(4,82%)
Max Close To Close Drawdown	(€2838,9)	(€1425,56)	(€3659,56)
Max Close To Close Drawdown (%)	(2,82%)	(1,43%)	(3,63%)
Return on Max Strategy Drawdown	0,07	1,03	(0,47)
Profit Factor	1,03	1,85	(0,64)
Adjusted Profit Factor	(0,67)	(0,97)	(0,35)
Select Profit Factor	1,03	8,74	(0,33)
Max # Contracts Held	1	1	1
Slippage Paid	€0	€0	€0
Commission Paid	€0	€0	€0
Open Position P/L	(€838,71)	(€838,71)	n/a
Annual Rate of Return	0,02%	0,25%	(0,23%)
Monthly Rate of Return	0%	0,02%	(0,02%)
Buy Hold Return	€62046,31	€63827,9	€62046,31
Avg Monthly Return	(€5,72)		
Monthly Return StdDev	€427,4		

Table 3.7: Strategy Performance Summary for DAX index



Total Trade Analysis			
	All Trades	Long Trades	Short Trades
Total # of Trades	47	23	24
Total # of Open Trades	1	1	0
Number Winning Trades	30	18	12
Number Losing Trades	17	5	12
Percent Profitable	63,83%	78,26%	50%
Avg Trade (win loss)	€4,94	€108,67	€94,48
Average Winning Trade	€316,55	€303,04	€336,82
Average Losing Trade	€544,97	€591,04	€525,78
Ratio Avg Win / Avg Loss	(0,58)	(0,51)	(0,64)
Largest Winning Trade	€661,83	€609,27	€661,83
Largest Losing Trade	€1566,88	€1287,61	€1566,88

Table 3.8: Total Trade Analysis for DAX index

Summary table with the five parameters of reference:

	All trades	Long trades	Short trades
Total Net Profit	231.96	2499.47	(2267.51)
Profit Factor	1.03	1.85	(0.64)
Percent Profitable	63.83%	78.26%	50%
Return on Account	8.17%	175.33%	(61.96%)
Maximum Drawdown	(3525.51)	(2417)	(4860.75)

The Maximum Drawdown does not change its negativity, as other elements of the short trades.

The most important thing is that, for DAX index, not only the long trades is appreciable but also the all trades, even if the profit factor value is not significant because lower than the range of 1.3-1.4, after which we have workable systems.

In conclusion, I consider the strategy under analysis a good one to test DAX index and in general German market.

3.2.5. FTSE100



Figure 3.10: Bar chart for FTSE100 with the application of the trading strategy

Analyzing the FTSE100 index, an important difference comes from both from the bar chart of the prices and from the equity line chart.

In the first, a positive element of the goodness of the strategy is given by the presence of large number green dotted lines, which mean lots of profitable possibilities from the research of divergences.

In the second, significant information comes from the direction of the trend: it is upward.

Next step is to confirm these hypotheses with the help of the report.



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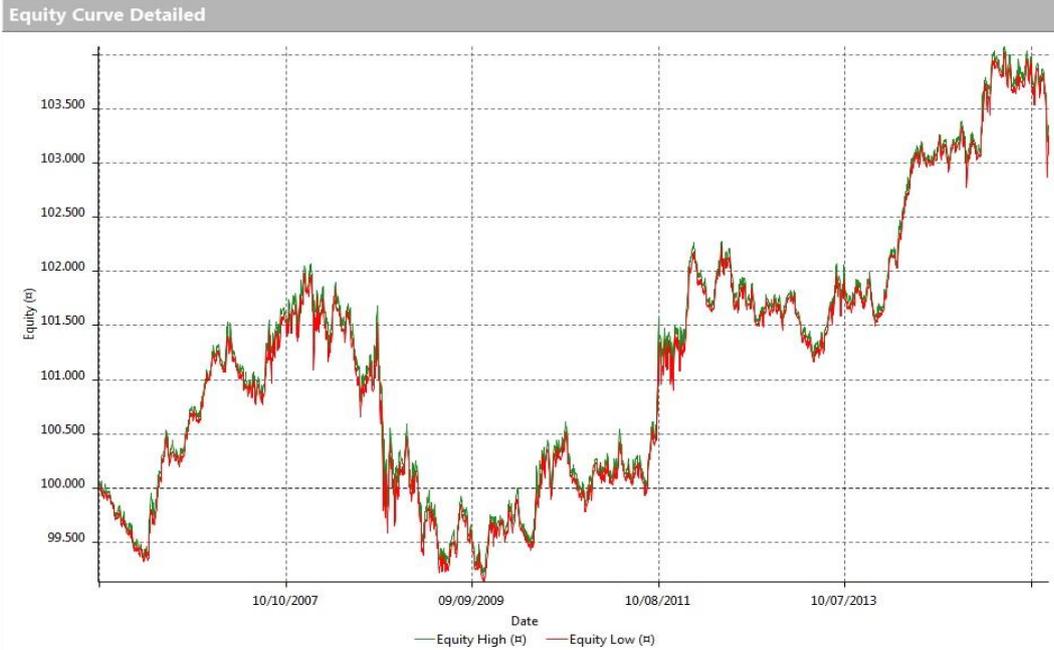


Figure 3.11: Equity line of FTSE100 index

Strategy Performance Summary			
	All Trades	Long Trades	Short Trades
Net Profit	€3934,8	€2652,1	€1282,7
Gross Profit	€8992,1	€5327,8	€3664,3
Gross Loss	(€5057,3)	(€2675,7)	(€2381,6)
Adjusted Net Profit	€1302,89	€423,86	(€293,53)
Adjusted Gross Profit	€7552,21	€4191,91	€2775,58
Adjusted Gross Loss	(€6249,32)	(€3768,05)	(€3069,11)
Select Net Profit	€3601,2	€3189,9	€411,3
Select Gross Profit	€7258,7	€4465,8	€2792,9
Select Gross Loss	(€3657,5)	(€1275,9)	(€2381,6)
Account Size Required	€2630,1	€2279,2	€815,9
Return on Account	149,61%	116,36%	157,21%
Return on Initial Capital	3,93%	2,65%	1,28%
Max Strategy Drawdown	(€2934,3)	(€2836,2)	(€1619,6)
Max Strategy Drawdown (%)	(2,87%)	(2,79%)	(1,6%)
Max Close To Close Drawdown	(€2630,1)	(€2279,2)	(€815,9)
Max Close To Close Drawdown (%)	(2,58%)	(2,25%)	(0,81%)
Return on Max Strategy Drawdown	1,34	0,94	0,79
Profit Factor	1,78	1,99	1,54
Adjusted Profit Factor	1,21	1,11	(0,9)
Select Profit Factor	1,98	3,5	1,17
Max # Contracts Held	1	1	1
Slippage Paid	€0	€0	€0
Commission Paid	€0	€0	€0
Open Position P/L	(€582,4)	(€582,4)	n/a
Annual Rate of Return	0,4%	0,27%	0,13%
Monthly Rate of Return	0,03%	0,02%	0,01%
Buy Hold Return	€14411,54	€13194,8	€14411,54
Avg Monthly Return	€28,41		
Monthly Return StdDev	€247,55		

Table 3.9: Strategy Performance Summary for FTSE100 index



Total Trade Analysis			
	All Trades	Long Trades	Short Trades
Total # of Trades	57	28	29
Total # of Open Trades	1	1	0
Number Winning Trades	39	22	17
Number Losing Trades	18	6	12
Percent Profitable	68,42%	78,57%	58,62%
Avg Trade (win / loss)	≈69,03	≈94,72	≈44,23
Average Winning Trade	≈230,57	≈242,17	≈215,55
Average Losing Trade	(≈280,96)	(≈445,95)	(≈198,47)
Ratio Avg Win / Avg Loss	(0,82)	(0,54)	1,09
Largest Winning Trade	≈871,4	≈479,8	≈871,4
Largest Losing Trade	(≈1399,8)	(≈1399,8)	(≈451,1)

Table 3.10: Total Trade Analysis for FTSE100 index

Summary table with the five parameters of reference:

	All trades	Long trades	Short trades
Total Net Profit	3934.8	2652.1	1282.7
Profit Factor	1.78	1.99	1.54
Percent Profitable	68.42%	78.57%	58.62%
Return on Account	149.61%	116.36%	157.21%
Maximum Drawdown	(2934.3)	(2836.2)	(1619.6)

Unlike the usual value of maximum drawdown which continues to confirm its negative direction, all the other four elements became positive in all the types of trades, in particular:

- Profit Factor are for all the three cases greater than the usual reference value;
- Percent Profitable are all significant and greater than the bound of 50%.

For all these positive evaluations I can again say that the strategy in exam is valid also for the UK market.



3.2.6. RUSSELL 2000

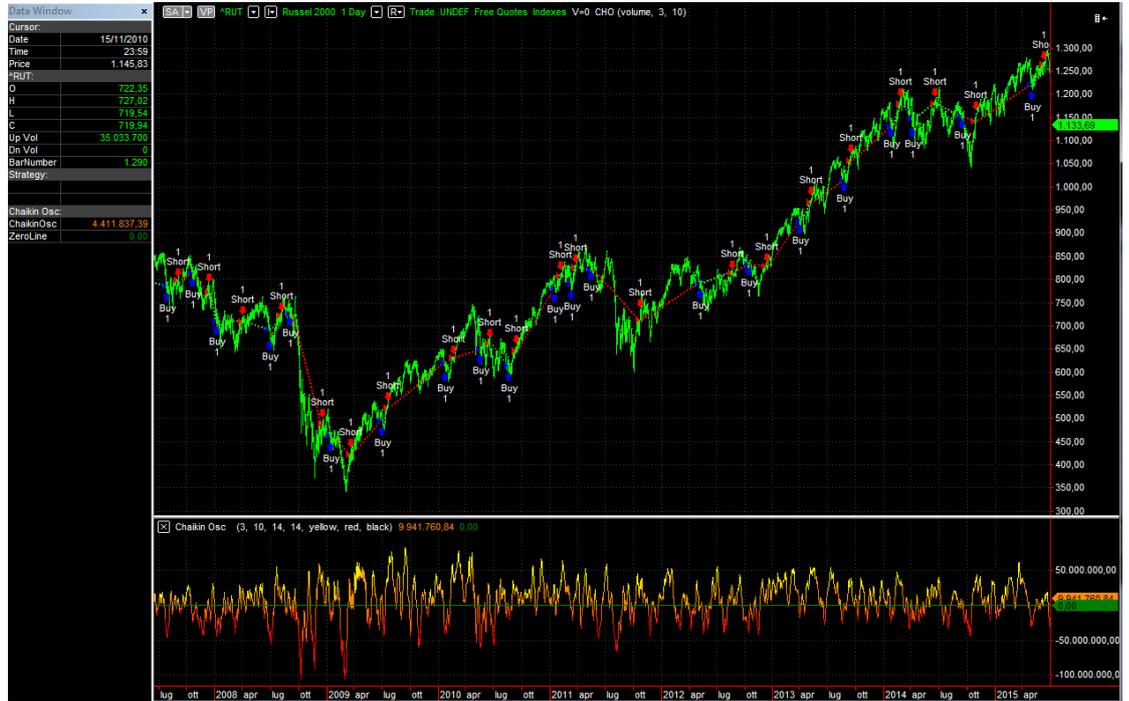


Figure 3.12: Bar chart for RUSSELL 2000 with the application of the trading strategy

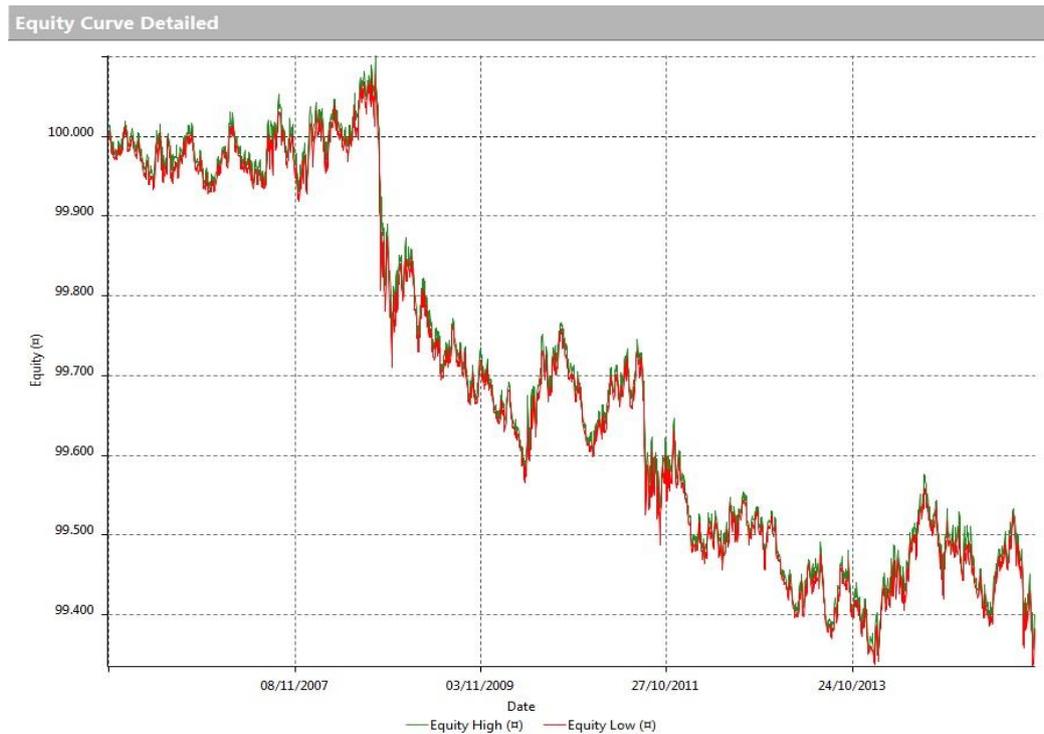


Figure 3.15: Equity line for RUSSELL 2000 index



From the figure 3.13 above, it is possible to understand that it is the same situation saw for DOW JONES and NASDAQ Composite indexes, because the decreasing trend.

Strategy Performance Summary			
	All Trades	Long Trades	Short Trades
Net Profit	(=495,48)	=44,2	(=539,68)
Gross Profit	=760,73	=487,86	=272,87
Gross Loss	(=1256,21)	(=443,66)	(=812,55)
Adjusted Net Profit	(=913,37)	(=251,91)	(=835,77)
Adjusted Gross Profit	=616,97	=372,87	=186,58
Adjusted Gross Loss	(=1530,34)	(=624,78)	(=1022,35)
Select Net Profit	(=367,12)	=148,95	(=516,07)
Select Gross Profit	=514,1	=352,47	=161,63
Select Gross Loss	(=881,22)	(=203,52)	(=677,7)
Account Size Required	=681,32	=290,56	=582,8
Return on Account	(7,72%)	15,21%	(9,26%)
Return on Initial Capital	(0,5%)	0,04%	(0,54%)
Max Strategy Drawdown	(=765,53)	(=395,36)	(=663,16)
Max Strategy Drawdown (%)	(0,76%)	(0,39%)	(0,66%)
Max Close To Close Drawdown	(=681,32)	(=290,56)	(=582,8)
Max Close To Close Drawdown (%)	(0,68%)	(0,29%)	(0,58%)
Return on Max Strategy Drawdown	(0,65)	0,11	(0,81)
Profit Factor	(0,61)	1,1	(0,34)
Adjusted Profit Factor	(0,4)	(0,6)	(0,18)
Select Profit Factor	(0,58)	1,73	(0,24)
Max # Contracts Held	1	1	1
Slippage Paid	=0	=0	=0
Commission Paid	=0	=0	=0
Open Position P/L	(=114,09)	(=114,09)	n/a
Annual Rate of Return	(0,05%)	0%	(0,05%)
Monthly Rate of Return	0%	0%	0%
Buy Hold Return	=70762,16	=65732,04	=70762,16
Avg Monthly Return	(=5,08)		
Monthly Return StdDev	=37,02		

Table 3.11: Strategy Performance Summary for RUSSELL 2000 index

Total Trade Analysis			
	All Trades	Long Trades	Short Trades
Total # of Trades	49	24	25
Total # of Open Trades	1	1	0
Number Winning Trades	28	18	10
Number Losing Trades	21	6	15
Percent Profitable	57,14%	75%	40%
Avg Trade (win loss)	(=10,11)	=1,84	(=21,59)
Average Winning Trade	=27,17	=27,1	=27,29
Average Losing Trade	(=59,82)	(=73,94)	(=54,17)
Ratio Avg Win / Avg Loss	(0,45)	(0,37)	(0,5)
Largest Winning Trade	=63,23	=48,93	=63,23
Largest Losing Trade	(=240,14)	(=240,14)	(=134,85)

Table 3.12: Total Trade Analysis for RUSSELL 2000 index

Summary table with the five parameters of reference:

	All trades	Long trades	Short trades
Total Net Profit	(485.48)	44.2	(539.68)
Profit Factor	(0.61)	1.1	(0.81)



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Percent Profitable	57.14%	75%	40%
Return on Account	(72.72%)	15.21%	(92.6%)
Maximum Drawdown	(765.53)	(395.36)	(663.16)

In all the case of RUSSELL 2000, the negative expectations are confirmed by the chart and the report analysis.



CONCLUSIONS

The elaborate has considered the possibility of evaluating divergences, created between the Chiakin indicator and the price of an index, as a signal to buy or sell for the trader who wants to invest in the market.

I analyzed some different indexes quoted in different markets with the use of a code properly created and I studied the related Bar chart, detailed equity line chart and the report realized with back testing in MultiCharts platform.

The first analysis has to be qualitative, with some indications in the graph, in order to understand if the strategy can have sense and it should be good implement it with a further analysis or if it is failed and it is better to abandon it.

After testing the code in all these indexes, I can say that for the US market the strategy does not work as the expectation predicted. This consideration is confirmed both from the Equity line chart and the five key elements a trader usually sees to base his test. Only in the long trades the hypothesis are verified. The operative idea seems to be valid and probably, with a more implementation of the strategy done until here, the result will be different and this could be a further interest of studying.

Indeed, a positive result comes from the analysis of the German and UK markets because, here, the values were in line with forecasts of a good strategy: in the equity line chart there is a gain margin due to the increasing direction or for most of it positive trend. Furthermore, the main parameters of the report confirm the prevision of the chart: the profit factor, which is one of them, for the two markets is greater than the range value that means workable system.

Concluding, this trading strategy examined in general showed good results and seems to be valid in all the markets even if in some of them the outcomes were not in line with the initial expectations.



APPENDIX

Codes created with MultiCharts, used for the analysis of historical data.

A. CHAIKIN INDICATOR USEFUL TO THE FOLLOWING CODES

```
INPUTS: AnyVol( numericseries ),  
        ShortLen( numericssimple ),  
        LongLen( numericssimple ) ;
```

```
VARIABLES: VAR0 ( 0 ) ;
```

```
VAR0 = AccumDist( AnyVol ) ;
```

```
CHAIKINOSC = XAverage( VAR0, ShortLen ) - XAverage( VAR0,  
LongLen ) ;
```



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B. SIGNAL BASED ON MINIMUM AND MAXIMUM TO 20 DAYS

```
INPUTS: MYVOL (VOLUME), FAST (3), SLOW (10);

// PLOT1 (CHAIKINOSC (MYVOL, FAST, SLOW) , "CHAIKIN" );

// PLOT2 (0 , "ZERO" );

{ALERT CRITERIA}

CONDITION1= HIGH>HIGHEST (HIGH, 20) [1] AND
CHAIKINOSC (VOLUME, 3, 10) <HIGHEST (CHAIKINOSC (VOLUME, 3, 10) , 20) ;

CONDITION2= LOW<LOWEST (LOW, 20) [1] AND
CHAIKINOSC (VOLUME, 3, 10) >LOWEST (CHAIKINOSC (VOLUME, 3, 10) , 20) ;

IF CONDITION1 THEN BEGIN

    SELLSHORT NEXT BAR AT HIGHEST (HIGH, 20) [1] STOP;

    ALERT ("A BEARISH DIVERGENCE HAS BEEN DETECTED");

    END;

IF CONDITION2 THEN Begin

    BUY NEXT BAR AT LOWEST (LOW, 20) [1] STOP;

    ALERT ("A BULLISH DIVERGENCE HAS BEEN DETECTED");

    end;
```



C. BASED ON THE ARRAY FOR BEARISH AND BULLISH SITUATIONS

```
INPUTS: MYVOL(VOLUME), FAST(3), SLOW(10);

// bearish case
inputs: dati(close);
variables: m(0), j(0), n(0);
array: A_MAX[3](0);

m = 2;

while m < BarNumber begin

// find the first maximum which satisfies the criteria
j = 0;
while j = 0 AND m < BarNumber begin
    m=m+1;
    if (dati[m]> dati[(m-1)] AND dati[(m-1)]> dati[(m-2)]
AND dati[m]> dati[(m+1)]
    AND dati[(m+1)]> dati[(m+2)]) then begin
        A_MAX[1] = dati[m];
        j = 1;
    end;
end;

// find the minimum which satisfies the criteria
j = 0;
while j = 0 AND m < BarNumber begin
    m=m+1;
    if (dati[m]< dati[(m-1)] AND dati[(m-1)]< dati[(m-2)]
AND dati[m]< dati[(m+1)]
    AND dati[(m+1)]< dati[(m+2)]) then begin
        A_MAX[2] = dati[m];
        j = 1;
    end;
end;

// find the second maximum which satisfies the criteria
j = 0;
while j = 0 AND m < BarNumber begin
    m=m+1;
    if (dati[m]> dati[(m-1)] AND dati[(m-1)]> dati[(m-2)]
AND dati[m]> dati[(m+1)]
    AND dati[(m+1)]> dati[(m+2)]) then begin
        A_MAX[3] = dati[m];
        j = 1;
    end;
end;
```



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```
end;

// bullish case
variables: mm(1), jm(0), nm(0);
array: A_MIN[3](0);

mm = 2;

while mm < BarNumber begin

// find the first minimum which satisfies the criteria
jm = 0;
while jm = 0 AND mm < BarNumber begin
    mm=mm+1;
    if (dati[mm]< dati[(mm-1)] AND dati[(mm-1)]<
dati[(mm-2)] AND dati[mm]< dati[(mm+1)]
AND dati[(mm+1)]< dati[(mm+2)]) then begin
        A_MIN[1] = dati[mm];
        jm = 1;
    end;
end;

// find the maximum which satisfies the criteria
jm = 0;
while jm = 0 AND mm < BarNumber begin
    mm=mm+1;
    if (dati[mm]> dati[(mm-1)] AND dati[(mm-1)]>
dati[(mm-2)] AND dati[mm]> dati[(mm+1)]
AND dati[(mm+1)]> dati[(mm+2)]) then begin
        A_MIN[2] = dati[mm];
        jm = 1;
    end;
end;

// find the second minimum which satisfies the criteria
jm = 0;
while jm = 0 AND mm < BarNumber begin
    mm=mm+1;
    if (dati[mm]< dati[(mm-1)] AND dati[(mm-1)]<
dati[(mm-2)] AND dati[mm]< dati[(mm+1)]
AND dati[(mm+1)]< dati[(mm+2)]) then begin
        A_MIN[3] = dati[mm];
        jm = 1;
    end;
end;
end;
end;
```



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```
// PLOT1 (CHAIKINOSC (MYVOL, FAST, SLOW) , "CHAIKIN" );  
// PLOT2 (0 , "ZERO");  
  
{ALERT CRITERIA}  
IF A_MAX[3]>A_MAX[1] AND  
CHAIKINOSC (A_MAX[1],1,1)>CHAIKINOSC (A_MAX[3],1,1) THEN BEGIN  
  
    SELLSHORT NEXT BAR AT CLOSE[A_MAX[2]] stop;  
  
    ALERT("A BEARISH DIVERGENCE HAS BEEN DETECTED");  
  
END;  
  
IF A_MIN[3]>A_MIN[1] AND  
CHAIKINOSC (A_MIN[1],1,1)>CHAIKINOSC (A_MIN[3],1,1) THEN BEGIN  
  
    BUY NEXT BAR AT CLOSE[A_MIN[2]] stop;  
  
    ALERT("A BULLISH DIVERGENCE HAS BEEN DETECTED");  
  
END;
```



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