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Analysis of the cumulative volumes, a strategy to anticipate the market

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Introduction

Since the end of last century, the major part of the stock markets have become electronic, changing the method in which they operate, from a structure where the traders inside the physical stock markets around the world purchased securities through shouting and hand signals, to a decrease in the role of the individual, who is now partially replaced by computers and automated trading systems.

The Italian stock exchange is Borsa Italiana S.p.A., informally known as "Piazza Affari". It is located in Milan and more precisely, headquartered in the "Palazzo Mezzanotte" building.

In 1998 it became a private company and incorporated other less important Italian stock exchanges. Since 2007 it has been a part of the London Stock Exchange Group plc.

Borsa Italiana has the task of managing and supervising the Italian derivatives markets (IDEM and MIF) and its fixed income market (MOT, Electronic Government Bond and Securities Market), where government securities and not-convertible bonds are exchanged. In addition, the EuroMOT is the Euro-Bond Electronic Market where brokers trade Eurobonds, bonds from foreign issuers and asset-backed securities [Borsa Italiana Website, 2015].

Today, every investor who wants to trade in the modern electronic market, has to pass through a financial intermediary, like for example a bank, an insurance company, or, a fund management company, authorized by the Financial Market's Supervisory Authority.

The transformation of Borsa Italiana to an electronic market was concluded in February 1996, when computers acquired a central role substituting agents inside the stock exchange to trade securities. It allows all brokers to access the market in the same period, and to know the exact price of each financial instrument in real time.

Borsa Italiana S.p.A.'s telematic system is based on IT infrastructures, with a central unit linked to all market operators' workstations. The system shows the negotiation proposal in a so-called book that all the authorized operators can access.

This evolution in the way investors and financial institutions trade securities has interested a number of market participants in continued growth; almost all institutional investors have adopted the super computer to set ultra-rapid trades; this new way of trading is also becoming more accessible to private investors; in a few years probably a large number of individuals will be able to easily programme computers to buy and sell securities, even when they are not in front of the screen observing the market.

The dimension of high-frequency trading is the most considerable in the US, where the daily average volume traded has grown 164% since 2005, and today in the American market 75% of securities are exchanged every day by computers (in 2005 it was only 30%). In Europe, the diffusion of this new method is lower, but is continually expanding and it is presumed that in the next few years almost all the trades in the world will be set by an automated trading system. In fact, an excellent competitive advantage is provided, considering that it takes only 30 milliseconds or 0.03 seconds to perform a trade, giving the possibility not only to complete the operation before others, but also to do many exchanges at the same time [New York Stock Exchange Website, 2015].

Chapter 1: Automated Trading

1.1 An Overview

Automated trading is an innovative solution, based on a computer program that allows traders and investors to enter and exit the market at precise and predetermined levels, and guarantees an extremely quick execution. It creates orders and automatically submits them to a market centre, or exchange; in addition, it allows money management rules to be decided in advance and once programmed, it can be automatically executed via a computer infinite times, and for as long as the trader has decided [Heires K., 2006].

The strategy at the basis of the trading system can be made up of simple conditions such as a moving average crossover, or differently, can be more complex, with many rules that work together and require a knowledge of the programming language of the adopted trading platform, or the engagement of a qualified programmer, in order to specify rules in the trading platform's proprietary language.

Also an exhaustive knowledge of financial markets, financial products traded, methods to analyse the market and portfolio management are essential to perform well with a trading system, even if it works automatically [Beddington J., 2012]. The technical indicators have the function to enlighten particular points in the strategy, when some conditions are verified or not; some are standard and available in every editor for trading systems language. Many traders, however, prefer to program customized indicators and strategies. Obviously, a tailored system or indicator requires more expertise, but it allows a much greater degree of flexibility and results can be more satisfactory.

Once the rules have been formulated and connected to each other, the trading system is created. In this way, the computer can monitor the market looking for buying or selling opportunities based on trader specifications.

1.2 Money Management

Money management is a discipline at the basis of each investment; it allows the risk to be reduced and is essential to dominate markets. In fact, some fundamental principles such as the

allocation and management of the available wealth need to be applied systematically in the trading system. Without money management rules, trading systems are not able to work.
Money management can therefore be defined as a combination of rules that are necessary to efficiently manage the available wealth and it can be divided into risk management and the position sizing. The first analyses the riskiness of a position in the market, while the second considers the wealth that can be invested in any trade and the repartition of the wealth among different financial instruments, with the scope of portfolio diversification as a way to reduce the risk [Lakonishok J., Shleifer A., Vishny R., 1992].

1.2.1 Diversification

Diversification is a technique introduced by the economist Harry Markovitz in 1952; it allows the firm-specific or diversifiable risk to be reduced only when the assets in the portfolio are correctly combined together, in particular, when their correlation is as low as possible [Harry Markowitz, 1952].
Efficient management of the risk permits maximizing the profit and minimizing the losses, independently from the kind of trading: automated or not automated. The key to the strategy consists in minimization of the risk and potential increment of the gains possible with an optimal asset allocation, based on the division of the investment portfolio across various asset classes like stocks, bonds, derivatives and money market securities, real estate and other financial instruments, with different peculiarities.
In this process of diversification, it is preferable to also consider geographical diversification, which means, the diversification of the investment portfolio across different geographic regions to reduce the overall risk and improve returns. In this way securities are not all connected, since they are not linked to specific events which occur in a specific country of the world. Also large multinational corporations, adopt geographic diversification, with the advantage to reduce expenses, transferring productions in low-cost jurisdictions and minimizing the exposition to currency volatility. In addition, corporation's revenues can be positively influenced by diversification due to the mitigation of investments in high-growth regions, compared to investments in lower growth regions. Furthermore, it can become convenient in case of political instabilities or wars in some parts of the world [Ansoff I., 1957].

A diversification strategy can be implemented also including in the portfolio securities belonging to companies in different stages of life. For example, a start-up company is considered attractive for the high expectancy of growth in the near future, but, the reverse of the coin is the possibility of bankruptcy due to the lack of liquidity, making it a considerably risky investment. It is also possible to invest in large cap companies, in an advanced stage of life, with a guaranteed but slow rate of growth. A portfolio made up of a mix of start-up, large cap securities and intermediate cap companies is an optimal combination with a satisfying return and an acceptable level of risk [Morningstar Website, 2007].

A consequence of the risk-return trade-off, is that, of course, when the return increases, also the risk grows due to the direct relation between the two components. Equities have the highest potential return, but also the highest risk. On the other hand, government bonds of developed countries have the lowest risk, since they are issued by the government, hence, providing the lowest potential return. Potential return rises with an increment of risk; it is proven that different assets present different levels of risks and market fluctuations. An efficient asset allocation protects the entire portfolio from the upward and downward movements that interest only a category of securities. More aggressive and consequently risky assets that provide a higher return, are balanced by other, less aggressive and less risky securities, with the result of an equilibrate portfolio in terms of risk and performance [Black F., Litterman R., 1992].

1.2.2 The Financial Strategy

The financial strategy that will be adopted by the trading system has to be adequate for: the wealth available, investor's risk aversion, the financial leverage, the margin required to open a position and the commissions [Barrett M., Scott S. V., 1999].

Risk aversion is the indisposition of a person to accept an investment with an uncertain payoff, rather than another with a more certain, but lower, expected payoff [Blavatskyy P., 2008].

For example, a risk-averse investor usually prefers to put his money into a bond with a lower but sure gain, rather than into a derivative that may have high expected returns, but also includes the possibility of losing all the money invested. On the other hand, a risk lover is an

investor that prefers the uncertain rather than the certain, in other words, he chooses to invest in very risky financial instruments instead of in a safe bond.

In terms of utility curves, the risk-averse investor has a higher utility from a sure but lower amount of money, with respect to an uncertain sum that can be either higher or lower than the sure one (Figure 1, Curve A); the opposite happens for the risk lover investor (Figure 1, Curve C). The intermediate case is represented by the risk neutral investor, indifferent to receiving a sure but lower amount of money, or a higher but unsure amount. He has the same utility in both situations (Figure 1, Curve B).

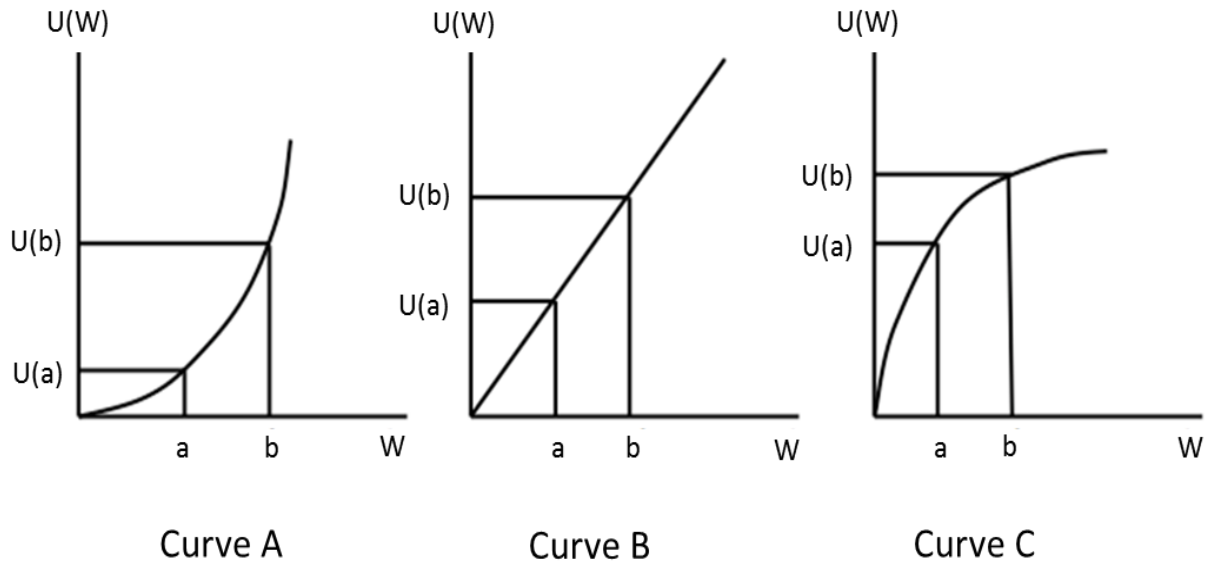

Figure 1: Utility Functions

Source: Author's elaboration

1.2.3 The Financial Leverage

Many derivatives available in the markets are levered instruments, implying that gains and losses are multiplied by the financial leverage coefficient of the contract chosen. The leverage allows buying more of an asset by using borrowed funds; the investor hopes in a return higher than the cost of borrowing to obtain a good gain [Aydemir C., Gallmeyer M., Hollifield B., 2007].

The financial leverage offers many advantages because it allows a consistent position to be opened with a little amount of money, and in addition, the gains are affected by the leverage. In practice, if there is $10,000 in the bank account and the bank allows a ten to one leverage (or 10:1, or 1000%), up to $100,000 can be invested; in other words, a position valued up to ten times the real money available in the bank account can be opened. Because of this big opportunity, it is easy to make a 10% profit, if that profit is made on capital 10 times higher than its real value. Furthermore, the leverage offers the possibility of employing the unused money to open a position in another investment.

It must be noted that at the same time, the leverage can be very dangerous because also losses are multiplied in the same manner as the gains and in a short time all the money invested could be lost, or, sometimes even a higher amount than the one invested. Considering that the leverage works in the same way in both directions, amplifying profits if things go well, but also amplifying losses if things go badly, the intervention of an authority entrusted to manage risk is necessary; that institution is named the Clearing House.

The first Clearing House was introduced in the Amsterdam Stock Exchange in the year 1602, to ensure that payments had been received and at the same time, the physical stock delivered.

Today, like in the past, there is an institution that surveys and regulates the markets. It acts as a counter party in all the opened trades, to be sure that no one is insolvent, and it manages daily profit and losses [Stringham E. P. 2003].

The Clearing House requires an initial margin to open a position in the market with a derivative instrument, and can be viewed as a measure of the statistical risk of the position from the moment it is opened till the following day and then day by day [Millo Y., Muniesa F., Panourgias N., Scott S. V., 2005].

Every day the investor's account is adjusted with gains and losses: when the opened position loses money, the initial margin has to be restored with the liquidity available in the investor's account. The amount of money necessary to restore the initial margin is called maintenance margin. The variation margin represents the real profit or loss of the position. If an investor does not have enough money in the account to cover the loss necessary to restore the initial margin, the position will automatically be closed by the Clearing House. For this reason, the investor has to integrate the account with new liquidity in order to restore the initial margin. The intention of this process is to protect the counter-party.

1.2.4 Commissions

Commissions are also included and must be considered part of the investments and evaluated during the choice of the financial instrument that will be traded. It is essential to optimize the trading commissions in order to get the best possible results out of the investment.
The three most used commission types are:

- Fixed;
- Variable;
- Mixture.

The fixed commission is based on a fixed amount that has to be paid independently from the size of the position.
The variable commission comprises an amount to be paid that is proportional to the amount invested.
The third type is a mixture of the first two and is based on a fixed commission plus a variable component proportional to the money invested [Sec Website, 2015].
In case of a variable or mixture commission, the trader should pay more attention: in fact, while the incidence of the fixed commission can be easily reduced with an increment of the amount invested, vice-versa this mechanism works only partially with the mixture commission and does not work at all with the variable commission because it is a percentage of the sum invested, unless the bank adopts a maximum commission value.
An important rule is to fix a maximum amount of the commission's incidence rate to be respected each time; a good parameter is an incidence of the commission over the total investment not higher than 0.20% for cash markets; indeed the percentage is different for futures markets.

1.2.5 Choosing the Broker

The rapid expansion of online brokers provides today's investors with many possibilities of choices. However different aspects must be evaluated since there is not a best broker and every trader has different requirements; so, the best solution must be designed on its needs.

The main element that has to be considered choosing the broker is the possibility of investments in terms of different markets and financial instruments and the price structure.

There are two main categories of brokers: specialized brokers and low-cost brokers [Financial Industry Regulatory Authority Website, 2015]. The first group provides professional features for experts and high-frequency traders, or, very exigent investors that have advanced and sophisticated needs. The latter class is more appropriate for the necessity of the average investors.

The low-cost is balanced by a restricted offer in terms of financial instruments to trade, market analysis tools and possibility of parameter customization.

Between the two categories fees are completely different, cost-per-trade varies a lot and professional brokers usually require a consistent minimum deposit. Hence, it is preferable to evaluate well which is the most suitable service, according to one's own needs, evaluating the strengths and the weakness because once the account is established, switching to a different broker means setting up a new portfolio and account which takes time and can imply fees.

In conclusion, each asset class has different levels of return and risk and investors should always consider their risk tolerance, investment objectives, time horizon and available capital as the basis for their portfolio set up. Investors with a long-term horizon and larger sums to invest usually prefer high risk and high return choices. On the other hand, investors with smaller sums and a tinier time horizon for the investment may adopt a solution with a lower level of risk and return.

It can be stated that each portfolio should be tailored in function of the necessities and preferences of the investor, considering as a first variable the risk propensity [Bell D. E., 1995].

The main goal of the trading strategy is to preserve the money invested before focusing on gains. This can be possible investing only a portion of the total amount available which should be between 20% and 50% of the total wealth, considering the investor's experience, the past performance and the risk aversion. This mechanism allows money to be preserved, so, in case

of a loss of the total amount invested, the trader can start his strategy another time with the remaining money.
A maximum drawdown which could occur during a trading session also has to be defined in order to stop trade for a period and adjust the strategy.
In addition, the 20% of the capital destined to be invested should be divided in small portion per trade, with the purpose of diversifying between different financial instruments and keeping a part of the money available to cover losses, or, to pyramid a position when it is profitable.
A value per trade not higher than 2 or 3% of the money ready to be invested (20-50% of the total money) is recommended. This portion can be increased a bit when the strategy is well tested and after having increased the initial amount considerably due to a relevant number of positive trades [Barber B. M. , Odean T., 2000].

1.2.6 The Position Sizing

The position sizing can be fixed or variable, determined time by time, following two non-risked-based-techniques: the fixed-share amount and the fixed-dollar amount [Davidsson M., 2011]. With the first method, the same number of securities is purchased for each buy signal every time. Differently, the fixed-dollar amount method involves the opening of a position with a determined and constant sum of money.
Another method is the Kelly Criterion, developed by John Kelly in 1956, [Hung J., 2010] which was introduced as a long distance telephone signal noise issue. Soon, after the method was published as "*a new interpretation of information rate*", however, the gambling community adopted the Kelly criterion for betting in horse racing. An useful and innovative technique, useful also in financial markets, to maximize the dimension of the bankroll in a long-term investment. Today, it is adopted by many investors as a general money management system.

There are two basic components to the Kelly criterion:

1. Win probability: the probability that any given trade made will return a positive amount;
2. Win/loss ratio: the total positive trade amounts divided by the total negative trade amounts.

These two factors are put into Kelly's equation:

Kelly % = W – [(1 – W) / R]

Where:

W = Winning probability

R = Win/loss ratio

This method assumes, however, that investors always trade in the same way, as in the past.

The output of the equation is the Kelly percentage, a number lower than one which represents the optimal size of the positions. For example, if the Kelly percentage results 0.05, then, each position should weigh 5% of the equities in the portfolio. In any case, the system requires common sense because even the formula suggests investing 50% or more in only one asset which is very risky, as Markovitz's theory suggests and the benefits of diversification will disappear.

The Kelly criterion is based on mathematic calculus. Despite originally being developed for telephones, it is currently applied in stock markets or gambling arenas. The system is effective only if the two variables are entered correctly and the actual performance of the investment strategy remains equal in the future.

1.2.7 Defining a Stop-loss

A stop-loss is essentially an order placed to automatically close an open position, when the underlying asset reaches a certain price and the loss becomes higher than a determined level [Osler C. L., 2001]. The goal of a stop-loss order is to limit an investor's loss on a position in a security and it can be set both for long and short positions.

The stop-loss should be set by any investor after each position is opened, especially when using an automated trading system, which implies that the person is not constantly in front of the trading platform. The objective is to preserve the capital, defining a priori which is the maximum amount that can be lost in the specific trading session.

Sometimes there can be collateral effects, for example, when the market and the stop-loss level are climbed over; in this case the position will be closed at a price lower than the set level,

implying a higher loss than expected. Vice-versa, a stop-loss order can close a position even if the investor does not want to close it. This situation, is frequent when the market is very volatile, and the stop-loss level set is not correct, in the sense that, an important downward movement in a positive trend involves closing the position. In any case, it is important to always set a stop-loss since collateral effects are lower than the possibility of losing the whole amount of money.

1.2.8 Defining a Take-profit

The take-profit, is an order used only by some traders, specifying before starting the trading session, the profit to catch in a particular position opened [Achelis S. B., 2001]. In detail, this type of order can be useful to close the position at a certain level of the market, with a sure gain; on the other hand, it is possible that this type of order automatically closes the position before the end of the upward or downward trend, leaving the market with a part of the possible gain.

1.2.9 Financial Instruments

Today in financial markets there are a lot of instruments that can be traded, with different peculiarities, options and futures and other derivatives require a high initial margin that is a guarantee for the broker. In addition, these instruments permit a lot of leverage that can be a great advantage because a position can be opened with an amount of money that is only a portion of the opened position. In any case, there is the downside: the higher the financial leverage of the chosen instrument, the higher the possibility of losing all the money invested very quickly due to the fact that both upward and downward movements are affected by the financial leverage. In particular every movement can be doubled, tripled, multiplied by 20, 50, or also 100 times with some financial instruments [Deutsche Börse Website, 2008].

1.2.10 Unsure Results

Unfortunately, a perfect money management system that always ensures gaining money does not exist. Every investor can set up his own rules, which become an useful method to efficiently set up the portfolio with the characteristics he finds most suitable, in terms of financial instruments adopted, necessary wealth, and diversification. Nonetheless, at the same time, there are many things that cannot be done, such as suggesting only winning stocks or ensuring a certain outcome. The final result, is always influenced by a certain amount of "luck" which can alter returns. It could happen that two traders who both adopt the same money management rules, in a different period, obtain completely different final results. The first could conclude the trading session with a positive result, while, the second, could finish the session with a high negative performance; randomness and volatility can cause temporary swings in account value. This means that money management is unable to ensure making spectacular returns, but its strength is to be able to limit losses and maximize gains by following the mentioned rules.

1.3 Construction of a Trading System Step by Step

The construction of a trading system is a process articulated in different phases [Mien C. W., Uzay K., 2013]. A presentation of the steps necessary to efficiently set up strategy follows:

A. Rule formulation

The preliminary operation consists of formulation of the basic rules, [Brock W., Lakonishok J., LeBaron B., 1992] simplex or complex, does not matter.

The design is the concept behind the system - the way in which parameters are used to enter and exit the market, generating profits or losses.

This scheme shows the paths from the basic rules to their application in the market:

Set of rules → Trading software → Broker → Automatic trading

A simple but useful example is presented in order to understand the basic rules of the formulation of a trading system:

1. Buy: determine when to open a position buying securities;
2. Sell: determine when to close a position selling securities;
3. Stop: determine when it is the appropriate time to cut losses;
4. Profit: determine when it is the appropriate time to take profits.

Specifically it can be decided to:

1. Buy: when the 30-day moving average crosses above the 60-day moving average;
2. Sell: when the 30-day moving average crosses under the 60-day moving average;
3. Stop: close the position after a maximum loss of 5 units;
4. Profit: close the position and take a profit after a gain of 5 units.

The example, shows how to formulate the basic rules to buy and sell securities when the 30- and 60-day moving averages cross, setting a stop-loss order after a maximum loss of 5 units and also a take-profit order to close the position after a gain of 5 units.

This is the simplest strategy possible, but it could be the basis for a more complicated strategy, with a simple improvement; the buy and sell signals can be the result of two or more parameters, as for example the simple moving average and the exponential moving average at the same time.

Rules like these that will be put into code, allowing the software to automatically generate entries and exits, when applicable.

In this phase of the creation of the trading system, it is essential to consider each one of the basic principles of investments, as just explained, in order to choose the most adequate financial instruments and consequently money management tailored for the instrument chosen. Thus the trading system is designed taking into account all these aspects is a good basis for a successful trading system.

Now it is possible to go on, and pass to the second step.

B. <u>Translation</u>

The second step consists of the translation of the rules at the basis of the trading system into the software's language, a language that a computer and specifically the trading platform is able to understand and turn into practice, buying and selling securities.

It can be done directly by the trader, when he has sufficient knowledge of a programming language, or else, an investor can engage a programmer which does the work for him.

The work starts with the individuation of the most suitable trading platform and editor for the trading system; there are many choices available: Multicharts, Tradestation, Wealth Lab, and Interactive Brokers, are just a few. Each one with specific peculiarities and functionalities that have to be evaluated in order to respond to trader's necessities.

Among trading software that support automated trading systems, only some automatically generate and place trades with the broker, while others are semi-automatic and will find trades that fit the selected criteria but require the trader to set the orders with his broker manually. Moreover, fully automatic trading programmes often require the use of specific brokerages that support such features; plus a trader sometimes has to complete an additional authorization form.

Implementing rules involves programming them. Sometimes, this programming can be done via a graphical user interface, a way that helps the trader to do some standard part of the activity quickly and easily.

Once rules are down, components involved in each rule must be identified. There are three kinds [Multicharts Website, 2015]: (1) signals, (2) indicators or studies, and (3) functions; all necessary in the construction of a trading system.

(1) A signal is the body of the trading system where the programmer sets all the actions that the software has to do. Commands for this operation have to be written in the editor of the trading platform in chronological order, so the trading system will always repeat all the operations in the same sequence. The signal is the part where signals to buy or sell are generated; in addition, reports are created and mathematical operations are computed.

(2) The indicator is a part of the trading system that shows the trader relevant situations or levels in the plot and alerts a trader with messages about specific conditions determined by him. An indicator can be represented with a line, point, cross, bar or a string with an alert. The name, is directly linked to the function that is covered in the program. Without signals, indicators cannot understand and show the levels at which to buy or sell.

The trading platform offers the programmer an infinity of standard indicators that can be adjusted to a specific necessity, or alternatively the trader can create on his own new and customized indicators which are more suitable for his signal.

(3) The function is a command that executes an operation giving back the result. Also in this case there is the possibility of using standard functions or of creating new ones. It makes sense to create a new function when there is the necessity to repeat the same operation many times in the trading system, hence it is sufficient to write the function in the code, instead of writing the operation included in the function every time. This can considerably reduce the time to complete the work and can also reduce the code length for a more tidy view of the program.

Each of the three elements just mentioned includes: (a) variables, (b) inputs, (c) "if-else" constructs, (d) "for" cycle, (e) "while loop", (f) "and/or" and (g) comments [Stridsman T., 2003].

(a) Variable, a value that changes in time, has to be initialized by the programmer with a default value. The editor for the trading system offers the possibility of choosing variables: numbers (the typology of numbers can be specified), boolean values (yes-no, 1-0), string (text), and array (many values organized in the same structure of a table).

(b) Inputs or statements are parameters that the user sets at the beginning of each trading session which remain invariant till the end of the session.

It is recommended to pay attention declaring inputs and variables in the correct way; inputs are set by the programmer and the trading platform provides the opportunity to optimize input values. This process will be explained in the following steps.

(c) Other necessary parts of the trading system are the constructs "if-else", based on a preliminary check of a condition and then, the execution of one or more actions, when the condition is true and other actions when the condition is false. There are particular cases with nestled "if-else", to check more than one condition simultaneously.

This is the usual if/else construction:

IF Condition

THEN Action (when the condition is true)

ELSE Action (when the condition is false)

(d) The “for cycle” repeats an instruction n times, till the condition is true, or not false. It is useful for counting or to execute a certain action for a number of times declared by the programmer.
(e) The “while loop”, is commonly used to tell the computer to continue doing a certain action, while a certain condition is true or false.
(f) The “and/or” are other components essential for the programmer, and are employed to indicate that both the items connected by “and” are involved, indeed “or” indicates that only one of the items is involved.
(g) Comments are also useful; it would be prudent to insert them in the code of trading systems with complex designs and very long structures, because they will help the trader understand it in the future and will also be useful for everyone the programmer shares the code with.

The combination of these components in a specific way allows the trading system to be programmed, declaring what it has to do in any circumstances, respecting what was decided in the first phase when the trading system was designed, starting from the basic rules.
At this point of the work, a guide of the trading platform could be helpful for the programmer as well as contact with the community of traders where it is possible to learn and clarify doubts.

C. <u>The preliminary test</u>

The vast majority of platforms for trading usually include testing tools which allow preliminary testing. The most used test is the back-testing tool which permits the new born trading system to be applied to past data.
The crucial moment starts with the acquisition in the trading platform of data regarding the financial instrument, or instruments chosen, or better linking the trading software to the data provider for the acquisition of the real time data. This modality provides the possibility of selecting at any time, the period of time of interest in which to test the trading system.
The result of the test is an initial feedback for the programmer about his work; it gives back two types of information: the first is whether the pc is able or not to recognize the specifications of the programmer and translate them into actions, and the second is that the strategy works - that it has the ability to make even little profits before any optimization process.

When the initial feedback is positive, the trader has to be satisfied with the first part of his work, otherwise negative feedback is usually the consequence of syntax and semantic errors. Most trading applications contain a feature that will let the programmer test his code before using or compiling it (converting the code into a file that the trading software can execute, or run, at any time). This feature is also able to locate syntax errors and fix them.

Sometimes the code is formally correct but the logic behind it is not exact and the trading system does a different action from the one the programmer expects. In this situation, it is necessary for the trader to take a step back and review the logic of the code, or if it is not sufficient, review the basic rules.

There are two ways in which the trader can apply his trading system [Algoritmica.Pro Website, 2014]: semi-automated systems, alert trader to new trades that satisfy the selected criteria, but trades are not placed automatically. This type of system surely implies a lower risk, but it requires the trader to be in front of the computer at all times. However, recent innovations have facilitated solving these inconveniences, sending alerts via email or phone to the trader, so that he is not obliged to pay attention to the computer all the time.

Automated systems are those that set trades automatically, so they do not need the constant presence of the trader. Obviously, this type of trading includes more risk, especially if there are logical errors that the programmer did not catch in the testing phase.

Therefore, it is imperative to test the system in a semi-automatic modality to be sure that it performs as expected in a live environment; only after this check can the computer be abandoned.

D. Optimization

Some trading applications allow for an optimal trading system, a process that finds the optimal value for particular elements; the analysis of the performance of a trading system is based on historical data in order to maximize the return, adjusted for risk [Campbell J. Y., Viceira L., 2005].

Over-optimization is the phenomenon that results in trading systems being unable to adapt to market conditions, where the values are different compared to the phase of optimization; therefore, it is important to optimize only a few relevant parameters, not all of them.

In practice, the process of optimization is based on a test of the inputs declared by the programmer. The optimization can simultaneously consider all the inputs, some of them, or

only one. The procedure consists of selecting the inputs to optimize, defining a range of values and a minimum unit for the process, so the program will not search for the optimal value to infinity for each input [Tucnik P., 2010].

Only a deep historical analysis, followed by an optimization process, can tell the trader which is the best choice for the money management rules to maximize a profit limiting risk.

Because of this practice, the trading system becomes most suitable for the data available for the test and considering that theoretically the future trend of an instrument should be similar to the past, the trading system should be more profitable.

E. Simulation

The simulation comprises the application of the optimized strategy to a series of out of sample data, that is, data that have not been used for the optimization of the parameters; doing this, it is possible to form an idea about the capability of the strategy to work on never seen data; in other words, it is the test that needs to be done before putting real money into the strategy.

F. Real application

The real application is crucial and consists of making the system work with real money and with the real time data of the financial instrument selected. At this time, the trader can verify with his eyes the functionality of the trading system and in the second place if it is profitable or not.

G. Results evaluation

Results of the real time trading need to be evaluated to verify their consistency with the results coming out from the back-test. Each time the software is improved, the new report has to be compared with the old one, to understand if the changes are convenient in terms of risk and profitability.

H. Improvement

Any working strategy can always be improved; optimization is a continuous process. This phase of the programming process requires more time compared to the previous phases. The aim of programming is reducing the timing, increasing the efficiency and simplifying actions, since the software has to be as short and easy as possible to respect the scope of the programming.

Changes of the code to improve it should be done one at a time, in order to come behind when the new variation is not convenient.
Hence a trading system with a well based concept, tested and optimized for long time, is a profitable strategy which recognizes a trader's labour [Pardo R., 2008].

1.4 Advantages and Disadvantages of a Trading System

Automated trading systems have several benefits, but at the same time, they also have downsides [Claessens, S, Glaessner T. Klingebiel D,].
The main advantages in studying the market and executing orders are presented:

- Minimize Emotions The automated trading process eliminates a trader's emotions because he cannot change the strategy if he should become irrational and wants to do it; in this system, the trader is not the executor, but only a supervisor, so he can concentrate on better money management rules to increase the profitability.
  When a profitable system is completed, it only needs to be adjusted by the trader due to changing market conditions.

- Ability to Back-test To back-test the strategy is a considerable advantage that consists of testing the strategy on past data; it permits the reliability and ability to generate money of the system to be verified. The analysis, at the end, provides system probability to gain or loss in relation to risk.

- Preserve Discipline The automated execution of the action defined by the programmer permits the discipline to be preserved, even in volatile markets, because till the trader modifies the trading system, it always works with the same criteria. The most common factor that leads to a loss of discipline in a trading session are irrational behaviours; often, fear in case of loss and euphoria in case of gain suggest keeping the position opened more than planned: this is avoided with automated trading that rigorously respects the plans. Plus it reduces trader errors to a minimum.

- Achieve Consistency Obviously, a trading system that is able to conclude 100% of trades with gain is not real, but an excellent system that wins 60 or 70% of the trades is real. Sometimes it happens that more than one trade is concluded with a loss, consecutively; this can generate trauma, so that after a series of losses, the trader tends to enter the market without observing the signals of the system, or sometimes he arbitrarily exits from the open positions, afraid of losing more money. Indeed, automated trading allows consistency to be achieved, maintaining the position open as was planned during the design of the trading system and to enter the market only in concomitance with the signals of the system.

- Order Entry Speed Between the several advantages of automated trading, there is also the speed to set trade, entering and exiting the market very quickly, as soon as market conditions meet the specifications of the trading system. A computer is able to set a trade in 30 milliseconds, a rapidness unimaginable for humans. Thus, computers are able to set operations in a fraction of a second permitting infinitive small variations of price to be obtained. The ultra-rapid trading is based on a huge number of trades with a very low average gain per trade.

- Diversify Trading Different accounts can be used to trade, thus allowing the use of plus than a trading platform. In this way it is possible to simultaneously run different strategies to diversify instruments traded, geographical areas and business sectors.

A list of the main disadvantages that affect automated trading systems is presented:

- Mechanical failures A system, when it is concluded can seem easy and infallible, but in most of the cases, it is not the case; some banal events, like an internet connection that does not work properly or the suspension of electric distribution causes serious problems to the automated trading that for example it is no longer able to execute orders in the market.

- Monitoring Although automated, the system requires a person for the supervision, to fix problems that may arise in the computer, or more precisely, on the trading platform in

order to re-start the trading as soon as possible. It is not imaginable to abandon a trading station; otherwise in case of problems no one is ready to repair it and the probability of losing an enormous amount of money increases continuously.

- Over-optimization Optimization allows parameters to be improved in order to maximize the fit of the trading system on the historical data series during the back-testing phase. Over-optimization is observable when a trading system that performs very well in the test phase produces bad results in the market with real time data.

Considering the higher number of advantages than disadvantages that automated trading provides, it can be stated that it is a very convenient tool, but it cannot completely replace the fact that in case of failure, if no one is supervising the station, the system is not able to re-start alone. For this reason an automated trading system is a powerful tool if used correctly by traders who are able to capture its positive effects while limiting its downsides.

Chapter 2: Psychology of the Trader

2.1 What is Risk

Many dictionaries define risk as “exposure to danger or hazard”. Thus, risk is perceived almost entirely in negative terms even if in Chinese language, the word risk is composed by the combination of two ideograms, the first symbol is for “danger”, while the second one for “opportunity”.

Figure 2: Danger, Opportunity

Source: The Sleuth Journal official Website, 2015

The Chinese definition suggests that risk is a mix of danger (crisis) and opportunity at the same time; each action is combined with the risk of failure, or with the possibility to have an outcome different from the one expected. The definition illustrates very clearly the trade-off that every investor and business has to face between higher rewards that come with the opportunity and the higher risks that are a consequence of the danger [Damodaran A., 2010].

Risk is inseparable from performance and rather than being desirable or undesirable, it is simply necessary.

Measuring risk, either upside and downside risks have to be considered; the former is the probability of a desired outcome, indeed the latter is the probability of the not desired one.

Furthermore in 2004, Holton states that at the basis of the risk's existence, there are two ingredients: uncertainty about the potential results from an experiment and also that the desired outcomes have to provide utility [Holton G. A., 2004].

The only way to completely eliminate a risk, consists in avoiding taking that action, but in this case neither the opportunity can be caught. So the basic point is that risk gives always an opportunity of important results for someone but also big failures for someone else. Obviously, the statistics has a fundamental role in risk's analysis. There are many models to evaluate if it is convenient to take a particular risk or not, the probabilities are very useful to this purpose. If the probability of failure is higher than the probability of the expected goal, a rational person will not run that risk, and vice-versa.

In an investment, risk is the *deviation from an expected* outcome [Chang K. J., Lin C., Zhu T., 2008]. The deviation can be in both directions: positive or negative, and it is connected to the idea of "no risk, no gain". To achieve higher returns in the long run, more short term volatility has to be accepted; this means risk is directly connected to expected return.

The volatility is the expected return between a period and the following one, or in other terms, it is a measure of the reliability of that expectation.

The level of volatility in the investment, depends on investment's risk tolerance, an expression of the *capacity* to assume volatility, considering specific financial circumstances associated, like the psychological comfort and the possibility of large short-term losses.

Standard deviation is a way to evaluate risk: a statistical measure that is used to quantify the amount of variation or dispersion of a set of data. A standard deviation close to 0 indicates that the observations tend to be very close to the mean, or expected value of the set, while a high standard deviation indicates that the observations are spread out over a wider range of values.

The risk in finance can be divided in specific, or unique, or diversifiable, that arises from decisions inside each company; specifically, the decision to make or buy products, the financial leverage, the business where the firm is in and company's structure; this source of risk can be reduced and theoretically can also be eliminated thanks to diversification. Also in market, or systematic, or not diversifiable risk, inherent to the entire market or an entire market segment, which does not affect just a particular stock or industry. It normally arises from: the inflation, the risk of failure of a country and other macroeconomic factors. The market risk is unpredictable and cannot be mitigated through diversification; in addition it affects each investment.

2.2 Behavioural Finance

Conventional financial theories consider the world, and specifically its participants, for the most part, rational and so "wealth maximizers", or "economic man" (*Homo Oeconomicus)* [Brzezicka J., Wiśniewski R.,].

However, in several situations emotion and psychology influence people and investors decisions, causing unpredictable or irrational behaviours.

Behavioural finance is a quite new branch of finance that combines behavioural and cognitive psychological theories with conventional economics and finance to explain the irrationality of people's financial decisions. This new field of study is based also on psychology and sociology to better understand some of the anomalies that the conservative finance has not considered, examining in depth causes and biases that generate irrationality [Shiller R., 1998].

The conventional finance, based on rational and logical theories, such as the Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory (APT) and other efficient market hypothesis, assumes that most part of the people are rational. If this is the case, the just mentioned theories work well giving an important contribution in predicting and explaining economic events.

However, academics in both finance and economics, started to observe and analyse anomalies and behaviours that couldn't be described by classical theories based on people's rationality, in order to explain and predict events with more accuracy, also in the real world, composed by a mix of rational and irrational investors. Forbes defined Behavioural finance as the study of how psychology influences the behaviour of investors and the subsequent effect on markets [Forbes Website, 2011].

An easy example of irrational behaviour is the purchase of lottery tickets. Many people hope of winning the big jackpot even if from a clearly logical and statistical view, it is not convenient to buy a lottery ticket, because the probability of winning is very close to zero. Despite this infinite low probability to win, millions of people continue to spend myriad of money in this game.

2.2.1 Important Contributors

Daniel Kahneman, and Amos Tversky are two Israeli psychologists, born in the second middle of '30s. They are considered the fathers of behavioural finance. Since their initial collaborations in the late 1960s, this duo has published about 200 works, a consistent part related to psychological concepts with implications for behavioural finance. In 2002, Kahneman received the Nobel Memorial Prize in Economic Sciences, for his contributions to the study of new economic models, more adapt to describe the real world. It was the first time that a psychologist achieved the Nobel in economics in fact he had integrated results of psychology's researches in the economic science, in particular with regard to the human judgment and the theory of the decision in uncertainty conditions [Kahneman D., 2003].

Kahneman and Tversky's research is focused fundamentally on the cognitive biases and heuristics, in particular their approach aims at clarifying and solving the source of people's irrational behaviours mainly in risk conditions.

Their most relevant work, is a collection of writings about investor's irrationality and their loss aversion. The classic theory, illustrated the ideal and rational ways to take a decisions, indeed, the prospect theory provides a description on the effective individual's behaviour, during decision processes. The work is based on the application of cognitive psychology's technique to the economic environment, to explain a series of anomalies frequently observable in the decision process [Kahneman D., Tversky A., 1975].

Also Professor Richard Thaler, an American economist born in 1945, during his studies in economics, recognized the shortcomings of conventional theories. Observing Kahneman and Tversky's works, in the field of behavioural finance, Thaler realized that, differently from conventional economic theory, the introduction of psychological in the economic field gave an important contribution to the understanding of the irrationality in behaviours, considering the new discipline as more adapt to well predict and describe the financial paradigm.

Thaler collaborated with Kahneman and Tversky, continuing to mix economics and finance with psychology, to present innovative concepts in the field, useful to understand irrational behaviours and other biases, frequent in people's life [Thaler R., 1992].

Without those contributions the behavioural finance field would not have evolved.

Behavioural finance, is not without critics. The exponents of the efficient market and the fully rationality, do not take in consideration irrationality in economics and finance. Professor of

Finance Eugene Fama, born in 1939 is the founder of the Efficient Capital Market Theory and is considered the major exponent of the behavioural finance's critics [Fama E., 1970]. He affirmed that the new school of thought that considers emotions, is "*more a collection of anomalies than a true branch of finance*". He states that some financial anomalies cannot be explained by modern financial theories, indeed he affirms that the conventional approach, was based on the perfect equilibrium of the market; the shorter-term imperfections are corrected automatically by the market over time, till the reinstatement of the equilibrium. Anomalies are the result of over-reaction to information, furthermore, anomalies are influenced by the technique used to measure them, and in most situations they disappear changing measuring technique [Fama E., 1997].

2.2.2 Anomalies

This paragraph consists in an explanation of some common anomalies that occurred frequently, violating the classical economic theories, leaving a space for behavioural finance. In fact it can be useful to know which are the most frequent investors' irrational behaviours, in order to avoid that actions, considering the disadvantages that they provide.

Nowadays markets are driven by a combination of either rational and irrational investors; identifying the irrationality is useful to understand and sometimes anticipate market movements, taking advantage on other investors.

Following a list of some anomalies, generated by irrational behaviours that affect the markets:

1. <u>Overconfidence</u>

Overconfidence is a financial behavioural bias that characterise finance, that influences people's decisions; it regards the degree of recognition relative to personal abilities and the awareness of individual's limits, that involve to an over evaluation of the owned abilities. Often overconfidence is a cause of arrogance [Barber B., Odean T., 2001].

A study concluded by James Montier in 1996 enlightened that 74% of the 300 professional fund managers surveyed believed that their work was above-average performance. The major part of the remaining 26% surveyed, viewed themselves as average.

Almost all the fund manager interested in the research, believed that the result was average or better, but undoubtedly, only half of the interviewed sample can actually be above average, showing these fund managers demonstrated high levels of overconfidence.

The peculiarity of overconfidence or exaggeration of one's ability to perform extraordinarily a particular job is diffuse in different fields. Every individual has been affected by overconfidence, thinking to win easily a challenge at the beginning, without taking into consideration all the possible difficulties before the conclusion of the contest [Montier J., 1996].

It is important to remember that there is a slim distinction between confidence and overconfidence. The first is based in trusting in own abilities, while overconfidence derives from an overly positive assessment of one's knowledge or control over a situation.

Applying the concept to finance, an investor can overestimate personal information collecting unfavourable results in the long run. A study conducted in 1998, by the researcher Terrence Odean, entitled "Volume, Volatility, Price, and Profit When All Traders Are Above Average", enlightens that overconfident investors, or traders, usually tend to believe they perform better respect others choosing the best stocks and best times to enter/exit a position in the market, conducting more trades than their less confident counterparts. But Odean's analysis shows that investors that conducted the higher number of trades, on average, were likely to collect significantly lower yields than the market [Odean T., 1998].

Remaining in the field of finance, the best fund manager is the one that knows each investment, every day presents a new set of challenges and that investment techniques constantly need adjustments, so every overconfident investor is constantly close to a possible ruinous end.

2. <u>Equity Premium Puzzle</u>

An anomaly observable in the market is the equity premium puzzle. According to the Capital Asset Pricing Model (CAPM), investors require a premium in term of higher rate of return to compensate the risk of financial assets.[Weil P., 1989].

Mehra, is a professor of economics and finance, researcher in the field of economic growth theory, capital markets and asset pricing models; Prescott is an American economist, he won the Nobel Memorial Prize in Economics in 2004, for his contributions to dynamic macroeconomics, regarding the driving forces behind business cycles. In 1985 they observed that return on stocks over the past century were a few percentage points higher than return

over government bonds. Economists expected that arbitrage opportunities would reduce the difference in returns on these two investment opportunities, restoring market equilibrium, to reflect the correct risk premium investors demand to invest in relatively more risky assets.

Stocks are much riskier than bonds but this explanation is not sufficient to justify the difference between the two returns. In fact the classical economic models, like the equity risk premium (ERP), implies an improbably high level of investor risk aversion.

The analysis conducted by Jeremy Siegel and Thomas MaCurdy over a 70-year period, enlightened that stocks yield average return exceeded government bonds return by 6-7%: the stocks real return was 10%, whereas bonds real return was 3% [Siegel J. J., 1991], [Siegel, J. J., 1992], [MaCurdy T., Shoven J., 1992]. The classical economic theories presumed a lower difference in returns, indeed an equity premium of 6% is extremely large and so, for the risk-return relation, the consistent yield spread implies that stocks are more risky to hold than bonds. This difference between the theoretical models of the common financial environment and the result from the market data represents a space for behavioural finance.

The new school of thought affirms that the equity premium puzzle, was generated by investors' "myopic loss aversion"; their tendency to be excessively scared by the downsides of losses than a gain with the same amount, in a very short-term, considering an investment.

This anomaly is generated by the fact that people focus their attention mainly on short term volatility of the stock owned in investors' portfolio, because it is absolutely normal that stocks price fluctuate a bit in very short periods of time.

The high premium that equity yield is correlated to investor's considerable aversion to loss (considering a short period of time) [Weil P., 1989]. The example is clear to state that the common financial theories are true and useful, but do not provide an explanation for all situations that happen in the real world. In cases in which the common theorems are not sufficient to explain the real situation, behavioural finance can further clarify how the financial markets work.

3. Anchoring

The concept of anchoring described in 1974 by Kahneman and Tversky, consists in attaching (or anchoring) the decisions to a reference point or a past experience, even though it may be not coherent with the actual problem to face. The phenomena of anchoring is most common in situations that regard new concepts, where there is not confidence.

In finance it represents a source of frustration, because investors often adopt irrelevant statistics or not correct models when taking investment decisions [Chandra A., 2008]. For example, some traders invest in stocks that have fallen considerably in a very short amount of time. In this case, the investor is anchoring on a recent "higher" level that the stock has achieved. Consequently the investor believes that the drop in price provides an opportunity to buy the stock at a discount.

Sometimes the price drop of a stock can be the consequence of a fall of the overall market, allowing investors to take advantage of this short-term volatility, but not always; in fact usually the downward movements, can reduce the value of the stock due to change in their underlying fundamentals. In the real market can happen that a company triplicates its share's price in a year, but the next one, the major customer which contribute to 50% of company's revenues, does not renew his purchasing agreement. By anchoring to the previous high price and observing the current low price, the investor erroneously believes that the company is undervalued. It is important to understand the fact that in this case the decrease of the price is attributed to the variation of company's fundamentals (drop of revenue from a big customer).

In this example, the investor has fallen prey to the danger of anchoring [Kahneman D. and Tversky A., 1974].

Therefore it is convenient to avoid anchoring and instead evaluate well the trend of a security before purchasing it, looking at which figures are used to evaluate the stock. In other words, a rigorous critical thinking is necessary in order to derive the realest picture of the investment environment.

These results suggest a multiplicity of directions for future researches in this field, the evidence just mentioned is a useful starting point to analyse prejudices and anticipate opinion without facts' evaluation [Jervis G., 1996Prejudice, Treccani Encyclopaedia], that arise in many situations and in the markets, altering investor's decisions [Campbell S. D., Sharpe S. A. 2012].

4. Confirmation Bias

Confirmation bias is a cognitive bias, it consists in an erroneous mechanism of inductive inference in regard with confirmation of the examined hypothesis. Errors and distortions in human information processing are documented since 1967 by Neisser and Adams [Adams J., 1967], [Neisser U., 1967].

It can be difficult to encounter something or someone without having a preconceived opinion. This first impression is hard to be modified, people also tend to selectively filter and pay more attention to information that support their opinions, while ignoring or underweighting that invalidate the initial hypothesis. This type of selective thinking is known under the name of confirmation bias.

In investing world, this field of studies suggests that an investor would be more likely to look for information that supports his original idea about an investment rather than seek out information that contradict it. So the bias can often lead to defective decision, leaving investors with an incomplete picture of the situation [Nickerson R. S., 1998].

For example, is common the case in which an investor is attracted by a hot stock after he has heard from an unverified source about its excellent performance, the phenomena of bias overshadows other negative characteristics of that asset [Gilovich T., Belsky G., 2000].

Researches, started in 1970, suggesting that people tend to confirm their acquired believes, evaluating only a partial of the available scenarios, limiting considerably the opportunity of choices. The tendency of the illusory, think that limits the human ability to manage information, precludes the conclusions [Gregory R. L., 1997]. In most cases a more accurate evaluation of the available information allows to achieve a better result; true in any aspect of life, including investment decision. So it is recommended to give the correct weight to past experiences and knowledge, assigning the priority to curiosity and new/innovative concepts.

5. Gambler's Fallacy

The gambler's fallacy, is a cognitive bias proposed by Amos Tversky and Daniel Kahneman, in which an individual erroneously believes that the probability of a certain random event decreases after that the event is happened. But it is not precise think in this way, because how the statistics suggest, events will happen in future with the same probability they have been happened in the past.

For example, a sequence of 50 coin tosses, all with the same outcome, induce to state irrationally that in the 51st tosses will result the opposite of the previous with a higher probability. The common way of thinking is not correct because the likelihood of head and tail is the same, so each one equal to 50% in a fair coin [Crites T. W., Shaffer H. J., Hall M. N., Bilt J. V., 2003].

Often, also traders or investors are overpowered by gambler's fallacy, there are some situation in which they close a winning position before the change of the trend, leaving to the market part of the gain, because in their head, after a sequence of events with the same outcome, the next one will be different. In the real world, it happens many times that a losing stock is kept in the portfolio because an irrational mind thinks that the future event will be the opposite of the past and the stock price will increase.

In order to avoid gambler's fallacy, it is convenient to adopt rational decisions, supported by fundamental and technical analysis choosing an investment [Dek Terrel, 1994].

6. Herd Behaviour

The philosopher Friedrich Nietzsche is one of the first to treat and criticize the herd mentality, and herd mentality psychology problems that affect human right and behaviours [Nietzsche F., 1886].

One of the most famous financial events in recent memory that is linked to the herd behaviour, is the bursting of the subprime mortgages bubble. But there are numerous events like this in the past, where the anomaly is clear and easily identifiable. The cause of the recent happenings is the herd behaviour, which is individuals' inclination to imitate actions (either rational and irrational), of a large group.

Usually this tendency is generated by a couple of reasons: the first is the social pressure of conformity, a powerful force that attracts each individual. In many situations a choice equal to the crowd is justified by the fear to be excluded from the group, due to the difference form the mass. The second reason that incites to follow group's decisions is believing that the choices have to be correct considering the huge number of individual that has adopted them. Even if there is the certainty that a particular idea, action or behaviour is irrational or incorrect, the final decision will be the same of the herd, believing that it is the correct one. This phenomena is prevalent mainly in not familiar situations, in which a person has very little or no experience [Banerjee A. V., 1992].

The subprime mortgage crisis of the last years was fueled by herd behaviour and it produced catastrophic outcomes all around the world. In particular the beginning of the financial crisis of the last years derives from the bursting of the bubble.

All began with a large decline in home prices, leading to mortgage delinquencies, foreclosures and the devaluation of housing-related securities. The recession was anticipated by a

remarkable drop of real estate's investments, a chain reaction was the reduction of family's spending power and consequently also firm's investments. The phenomena was more clear in the poorest regions, where most families that purchased a home with a mortgage had not a secure work as a guarantee of a constant cash flow that permitted to pay back the borrowed amount. The first effects in that areas were the houses' price decline, that rapidly contaminated the entire economic system.

The expansion of household debt was financed with mortgage-backed securities and collateralized debt obligations (financial instruments designed by the financial sector mixing fractions of mortgages and other credits, to transfer the risk of not receiving the payments to someone else), which initially offered attractive rates of return thanks to the high interest rates applied on mortgages. The only heavy motivation that lead investors to sink their money into mortgages circuit, was the possibility of interesting returns; in the period before the bubble the opportunity of gain was real and attracted day after day an increasing number of irrational investors, that remain burned with the progressive decrease of the credit quality. The signals of the crisis became more visible in 2007, and quickly a massive default affected the whole system, since September 2008, several major financial institutions collapsed, with significant effects in the global economy, currently still perceptible [Haiss, P., 2010].

As the recent subprime mortgages bubble illustrates, usually it is not very profitable to follow the decision of a group of people or investors. The evidence shows that investors that employ a herd mentality investment strategy, constantly change their investment strategy, adjusting portfolio's composition, substituting assets with others, newer and "hotter". This strategy in most cases not convenient due to the high amount of transaction costs that derives from the high number of transaction requires to frequently adjust the portfolio. Moreover it's extremely difficult to hit the precise timing in which to open the position and collect all the possible gain (from a minimum to a maximum, looking the price chart of a security).

In many occasions, the temptation to lead the mass, assuming a herd behaviour is high. But the past events help to understand that most times it is better to think rationally, evaluating either the convenience and the side effects of an investment or of each actions, even if a huge number of people suggest and make that specific investment. Therefore, the counsel is to always do the necessary evaluations analysing the entire situation, before following any tendency, in particular massive trend. In addition an investment decision taken in accord with the herd, can be profitable only at the beginning, but not in the future, in particular when a

huge number of people make the same investment. Often the high return of an investment can be influenced by investor's excess of optimism [Das S., Levine C. B., Sivaramakrishnan K., 1998].

7. Overreaction and the Availability Bias

Emotions in stock markets are misleading, a common consequence is overreaction toward new information. According to market rules, information should influence instantly security's price. So good news should raise share prices and also the price should remain constant till the release of a new information [Shiller R. J., 1984].

In the markets this theory is not always valid: oftentimes, who operates in stock markets, is irrational and overreacts to new information, influencing the stock price excessively respect the relevance of the news.

Two experts of behavioural finance, Werner De Bondt and Richard Thaler, published in 1985 the result of their study on market overreaction. It was based on the returns' analysis on the New York Stock Exchange for a three-year period. The researchers separated the stocks in two groups, the best 35 performing stocks, into a "winners portfolio" and the worst 35 performing stocks, were then added to a "losers portfolio". The researchers registered each portfolio's performance against a representative market index for three years. The losers portfolio consistently exceeded the market index, while the winners portfolio consistently underperformed. At the end of the period considered for the study, the cumulative difference between the two portfolios was almost 25%. In other words, it appears that the original "winners" would became "losers", and vice-versa [Werner F. M. De Bondt; Richard Thaler, 1985].

The results achieved in both portfolios were influenced by the effect of investors' overreaction to information; in the case of loser stocks, investors overreacted to bad news, driving the stocks' share prices down disproportionately. In the real world, after some time, investors realized that their excess of pessimism was not justified at all; when investors understood that stocks were undervalued, they inverted their reaction pushing up the price. The vice-versa is true for the winners portfolio where investors realized that their exuberance wasn't totally justified.

The most important thing that allows to avoid this irrational behaviour is to hold a sense of perspective; analysing an investment strategy means to study the economic situation in a long

period of time, while a short period approach frequently provides not precise information due to investor's overreaction on latest news.

8. Prospect Theory

The prospect theory, presented in 1979 by the studious Kahneman and Tversky states that people value gains and losses differently (not with the same weight) and the future decisions are based on perceived gains rather than perceived losses.

Conventionally when evaluating an investment performance, gains and losses are considered together in order to calculate the total result, in relation to the level of risk of that investment.

In the academic background the term "utility" represents the satisfaction provided by an investment. Reasoning in terms of utility, in a pool of investment the preferred are the ones with the highest utility for the investor [Hwang S., Satchell S, 2001]

People are distressed against losses and according to the Prospect Theory, losses have more emotional impact than an equivalent amount of gains. For example, in a rational way of thinking the amount of utility achieved from receiving $50 should be equal to the utility provided by another situation in which an investor gains $100 and then loses $50. Mathematically, both circumstances have the same outcome, a net gain of $50, but most consider the first situation more favourably than the second.

The prospect theory showed that for an overwhelming majority of people, losses are weighted more heavily than an equivalent amount of gains [Kahnerman D., Tversky A., 1979].

What has just been described can be graphically represented as shown in figure 3.

Figure 3: Gain and loss

Source: Kahneman D., Tversky A., 1979

The asymmetric value function shows the difference in utility (amount of pain or joy) that is achieved in case of gain or loss of a certain and equal amount.

The different perception of gain and loss, is a general trend but it is not correct to assume that everyone thinks in this way. The most evident feature is how a loss creates a greater feeling of pain compared to the joy created by an equivalent gain; in the plot it is easily observable that the joy provided by a gain of $50 is absolutely lower than the pain caused by losing $50.

The prospect theory provides an explanation of few illogical financial behaviours. In fact some people are adverse to deposit money in the bank to earn interests or refuse to work overtime because they do not want to pay more taxes. The prospect theory suggests that the benefit or utility from the extra money (after-tax income), is not enough to overcome the feelings of loss incurred by paying taxes [Dhami S., Al-Nowaihi A., 2007].

Prospect theory also explains the disposition effect, which is the tendency for investors to hold on losing stocks for too long and vice-versa sell winning stocks too soon. Indeed it is more logical to sell loosing stocks to limit the losses, avoiding to remain with no money and at the same time winning stocks should be maintained in the portfolio, in order to gain money [Weber M., Camerer C. F., 1998].

It is possible to minimize or eliminate the disposition effect by using a more rational mental approach, focusing on the final outcome of the investment in terms of utility or net gain, keeping emotions apart. In case of a consistent loss verified because the loosing stocks have been kept in the portfolio, the worst action to do is to try to recover the loss with more aggressive, and consequently risky financial instrument, since the probability to lose the entire capital is very consistent.

2.2.3 Behavioural Finance and Systematic Trading

The just presented cases of irrational behaviour give the opportunity to understand some of the situations in which people and investors are not completely rational.

Everyone, almost surely, has had an irrational behaviour during life, against the conventional economic theories of wealth maximization.

Behavioural finance, the new branch of finance, is applicable when the classic theorems and rules that manage and forecast the market do not always provide correct results; the behavioural finance studies and tries to explain why individuals do not constantly make the decisions they are expected to make and why markets do not reliably behave, as they are expected to perform, especially in the short-run.

Recent studies show that the average investors make decisions based on emotion, not logic [Lucey B. M., Dowling M., 2005] in addition behavioural finance justifies some irrational behaviour, demonstrating how emotions often play a pivotal role in investor's decision, leading investors to make irrational financial decisions, in some situation counterproductive for the wealth maximization.

The union of behavioural finance and automatic trading is a perfect mix that allows to achieve excellent performances, studies on the irrationality between investors show how popular and how damaging these biases are during an investment. Thanks to this branch of finance, investors are aware of behavioural anomalies and with a bit of intelligence and shrewdness emotions can be kept apart. Furthermore automated trading offers the possibility to take decisions and formulate strategies that will work in the market automatically with the advantages that irrational actions can be avoided, designing the strategy efficiently, respecting the basic principles of money management. Furthermore, the automatic execution of the

actions in the market, by the trading system permits traders to maintain always the same strategy, in this way the trader is not the executor, and does not risk that emotions drag him to close a position before or after it has been planned in the phase of strategy design.

Chapter 3: Technical and Fundamental Analysis

3.1 Background

The last decade has been fundamental for the investments' modernization, many changes happened. Today, everyone has the possibility to invest money in financial markets, even if not very confident with economics and finance; in addition, only a little amount of money is required to trade.

The big change, began with the arrival of the electronic market, in the last decade of 1900's, from that moment the market become accessible via pc, popularizing finance; in fact, today, thanks to the available advanced computers at a bargain, it is possible to invest money in financial markets being sit on a sofa at home, or elsewhere. Brokers are specialized: some have created easy and cheap solutions for beginner investors; others offer advanced services to institutional investors, which require a high level of precision and the possibility to trade every type of financial instrument. Furthermore, the financial innovation and the consecutive financial popularization, reduced information transaction costs and facilitated the trading, diversification and management of risk, ensuring that the financial system can provide these functions more efficiently [De Haan J., Oosterloo S., Schoenmaker D., 201].

The diffuse access to financial markets allowed the economy to grow, thanks to the continue increment of volumes traded and the investor's demand for new financial products. The innovation of the financial sector differs from other types of new product development in several aspects; the financial system is completely interconnected, so the changes in the process interest the whole financial environment.

The IT technologies, have reached a high level of development, offering power calculators, able to process an enormous amount of data per second; characters required by the modern software for the automated trading. Furthermore, the innovative and efficient instruments for trading have the capability to set and manage a huge quantity of trades simultaneously.

As explained in the previous section of this work, emotions have to be kept apart to perform well in financial market, using rationality to make investment decision.

The most adopted criteria to evaluate investments and manage them, are fundamental and technical analysis.

3.2 Fundamental Analysis

The aim of the fundamental analysis, is to evaluate the fair price of a financial instruments. To do so, are evaluated balance sheets and key ratios to investigate about firm's health; are considered also microeconomic aspects, the economic environment, inflation and risk free rate. In other words, fundamental analysis consists in the study of the company's situation at 360 degrees, to prevent prices' fluctuations.

Theoretically, it suggests when a security is under or overvalued: in the first case, it is convenient to buy the security because the market price is higher than the fair one and in the second case, the opposite [Lev B., Thiagarajan S.R., 1993].

It is very complex to consider all the factors that contribute to the price movement; for this purpose advanced econometric models are used, with the objective to simplify the process, but, due to the long time the analysis takes, in some occasions the fair price changes before the end of the evaluation. In addition, this approach is based on market's efficiency, but, this does not always represent reality, in fact behavioural finance demonstrates that some investors are driven by emotions and irrationality, generating strange price movements in the market.

Generally, fundamental analysis provides good results in the evaluation of long-time movements; at the same time it is not valid to forecast short-period variation (period shorter than a month).

In any case, it is important to consider also the economic calendar and the main financial events that regard the company, because the market can have unexpected movements closely to the release of financial news.

In the interpretation of the results provided by the fundamental analysis it has to be remembered that the market often anticipates the forecasts, in the sense that, often, the release of a positive news is combined with a downward movement of security's price. The reason can be traced on a price growth, the previous days, based on the expectation of the good news release. Vice-versa, the price may fall before negative news and the release coincides with a change of the trend, followed by an upward movement the next days.

Most times, it is necessary to anticipate the market to take profits. Furthermore, fundamental analysis, even if useful to predict long term market's fluctuation, requires a lot of time to obtain all the necessary information; only sophisticated automated trading systems are able to adopt fundamental analysis to generate buy and sell signals [Holthausen R, and Larcker D., 1992].

3.3 Technical Analysis

Differently from the previous approach, technical analysis is not able to suggest fair prices for securities, in addition it does not consider the market as perfectly efficient. It retains that almost always emotions are present in financial markets, influencing human behaviours and as a consequence, prices.

This technique is based only on the interpretation of the market price of a security, analysing the plot to understand the price's direction. The milestone of the technical analysis, is that prices include each type of information: fundamental, political and psychological factors. If a price of a good increases, it does so because there are more buyers than sellers: demand is stronger than supply and vice-versa. When the price drops or raises there is always a reason, but not relevant for technical analysts. If the price of a good is increasing, it means that the market, on average, thinks that its value is higher than its price; hence, for the determination of the prices counts only the sum of the expectations of all the operators in the market [Kirkpatrick C. D., Dahlquist J. R., 2010].

Market movements, follow a trend, that remains unchanged for a not constant period of time and it is generated by the market itself. There is a systematic repetition of the historical patterns in the future; so, it is valid to think that an outline similar to one in the past can indicate the future prices evolution.

The past becomes useful to suppose the future trend, thanks to the inferential statistics, based on systematic procedures, to infer things about general characteristics of the observed data.

The correlation between the statistics and the technical analysis is a key point on the validity of the second one. Doubting about its effectiveness means contradicting the efficacy of every price forecast based on historical data, including fundamental analysis [Lo A. W., Mamaysky H., Wang J., 2000].

Technical analysis, thanks to the price chart, suggests investors the right market direction and the right time, in order to maximize profits, minimizing losses; it enlightens also levels at which enter and exit the market. It is the best solution for intra-day investments, or, for investments in a period lower than a month and is at the basis of each trading system's strategy.

The technical analysis is not magic, being based on suppositions, it is not infallible and results are appreciable when they are correct 60 or 70% of times. Basically, this methodology usually is able to individuate the current trend, but investors do not have the presumption to take profit

from all the trends, because it is impossible to buy at the minimum price and sell exactly at the maximum price of the trend.

3.3.1 Line Chart

The tool at the basis of technical analysis is the chart; with the graphic representation of a historical series of prices and/or volumes on the y axes and time on the x axes (according to the time frame selected to analyse the plot); modern software for technical analysis, or the trading platforms, offer many variants to illustrate data in the plot.

The line chart, is a continue line that joins each closing price; the last price of a trading day is considered the most relevant, because it represent an equilibrium price of the day; all investors, regulators and institutions, base their decisions on that price [Putniņš j. and Forde C., 2006].

Figure 4: Line Chart

Source: Author's elaboration

The strength of this type of plot is the easy and quick interpretation, but at the same time it presents a relevant lack: it does not show the day-volatility and the day-trend; in other words, it is not possible to learn if the opening price is higher or lower than the closing price and the price fluctuations during the day, or, at a different time-frame.
The line chart, is adapt to focus the attention only on closing prices.

3.3.2 Bar Chart

The bar chart, is an illustration of the price during the entire day, or, for the time frame selected, from the opening price to the closing price; it is composed by vertical bars for the excursion between the maximum and the minimum price in the selected time interval, plus a horizontal segment on the left, for the opening price, and another horizontal segment on the right, for the closing price, like illustrates figure 5.

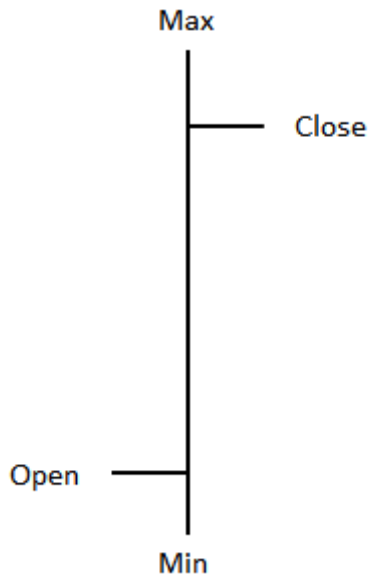

Figure 5: A bar of the Bar Chart

Source: Author's elaboration

This plot, differently from the last one, shows the volatility and the trend of the price. The time frame of the bar can vary from a minimum of 1 minute, to a year, or, more, through time frame of an hour, a day, a month. This type of chart, provides more information than the previous: it represent open, high, low, close prices, relative position of close versus open and daily range. In a quick sight of the plot it provides an immediate information about the direction of the price and a measure of the level of stress in the market (in a phase of high stress the bars are very wide) [Cohen A.W., 1984].

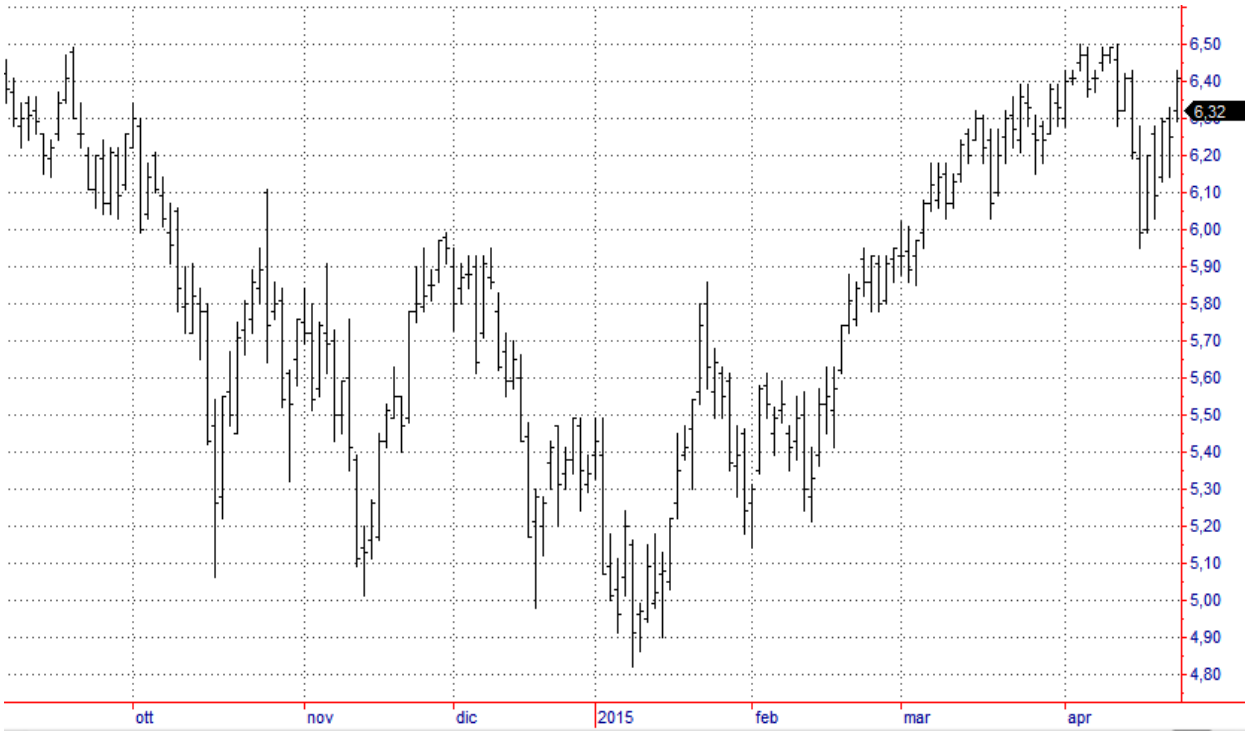

Figure 6: Bar Chart

Source: Author's elaboration

3.3.3 Japanese Candlestick

Japanese candlestick, is a graphical representation with ancient origins, adopted for the first time in Japan, during the 17th century, to forecast the future price of the rice and still widely

used today. But, its modern employment started in US over thirty years ago and later in Europe [Nison S., 2002].

In the candlestick plot, like in bar chart, price movements during the entire day, or, of the different selected time frames, are considered, but it differs from the previous type of chart in the graphical shape. In the candlestick plot each price appears at a certain level of a vertical rectangle, called body of the candle; the dimensions change in every candle, reflecting the price variation in the time frame. The body of the candle is green or white when the closing price is higher than the openings and it is red or black in the opposite situation. The size of the body represents the strength of the price movement. At the extremities of the candle there are two vertical segments called shadows: in the top the maximum value is represented, while in the bottom the minimum of the day, or different time frame is shown. The length of the shadows, differently from the size of the body, give an idea of the market indecision.

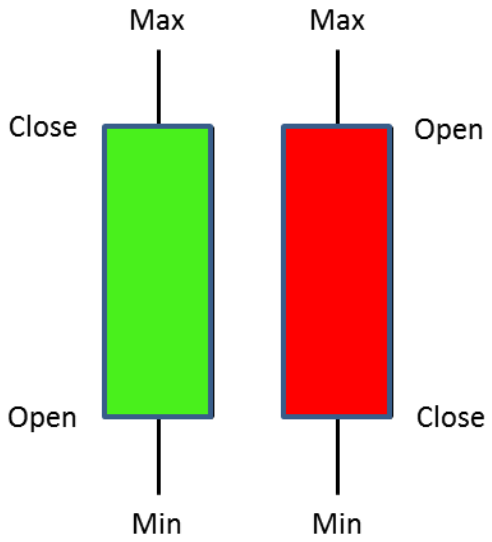

Figure 7: Candlesticks graph

Source: Author's elaboration

Basically, the Japanese candlestick graph provides the same information of the bar chart, but it offers an immediate interpretation, understanding the direction of the market, thanks to the

colour of the bars. This typology of plot, can be interpreted as a single pattern, in pairs, or, in series of three, or more [Murphy J., 1991].

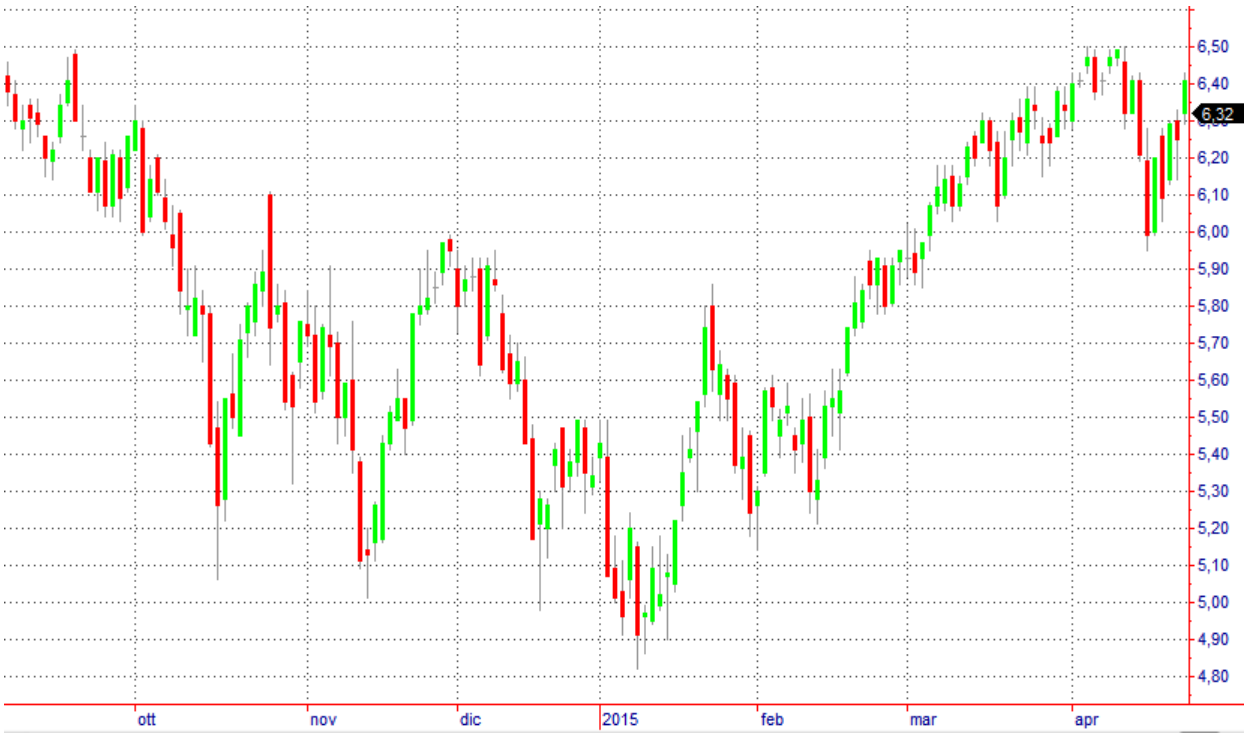

Figure 8: Japanese Candlestick Chart

Source: Author's elaboration

Candles can assume different shapes according with the dimension and the colour of the body and the length of the shadows. Technical analysts use particular names for these specific conformation, as shown in figure 9 [Candlecharts Website, 2015].

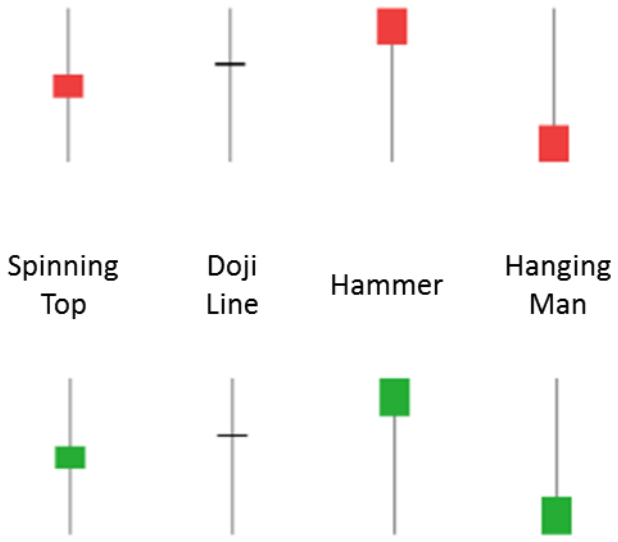

Figure 9: Candlestick Patterns

Source: www.candlecharts.com

3.3.4 Supports and Resistances

Analysing the plot of the stock price, critic levels where the market seems to hesitate are frequent. In that levels, asks and bid do not reach a common point and the transactions do not happen.

A support is characterized by the strength of the bid side, because the ask side is not able to dominate. It is a line that joins two or more minimum points in the plot pushing up the price, preventing its fall under some specific level. Each time it is tested without breakage it becomes more relevant and significant. Surely, a historical minimum represents a support, but also other important relative minimums, are noteworthy supports.

On the other side, a resistance is characterized by the strength of the ask side, while, the bid side is not able to dominate the market. It is the upper line in the plot (figure 10), that joins two or more maximum points and pushes down the price. Also a resistance acquires strength each time it is tested but not broken. A historical maximum represents a resistance, like other important relative maximums.

Empirical experience shows that a broken resistance, tends to become a support and vice-versa; this is called the state change postulate: when a border line is crossed, it tends to change

its nature; specifically what once pushed up the price, now pushes it down, and vice-versa [Murphy J., 1999].

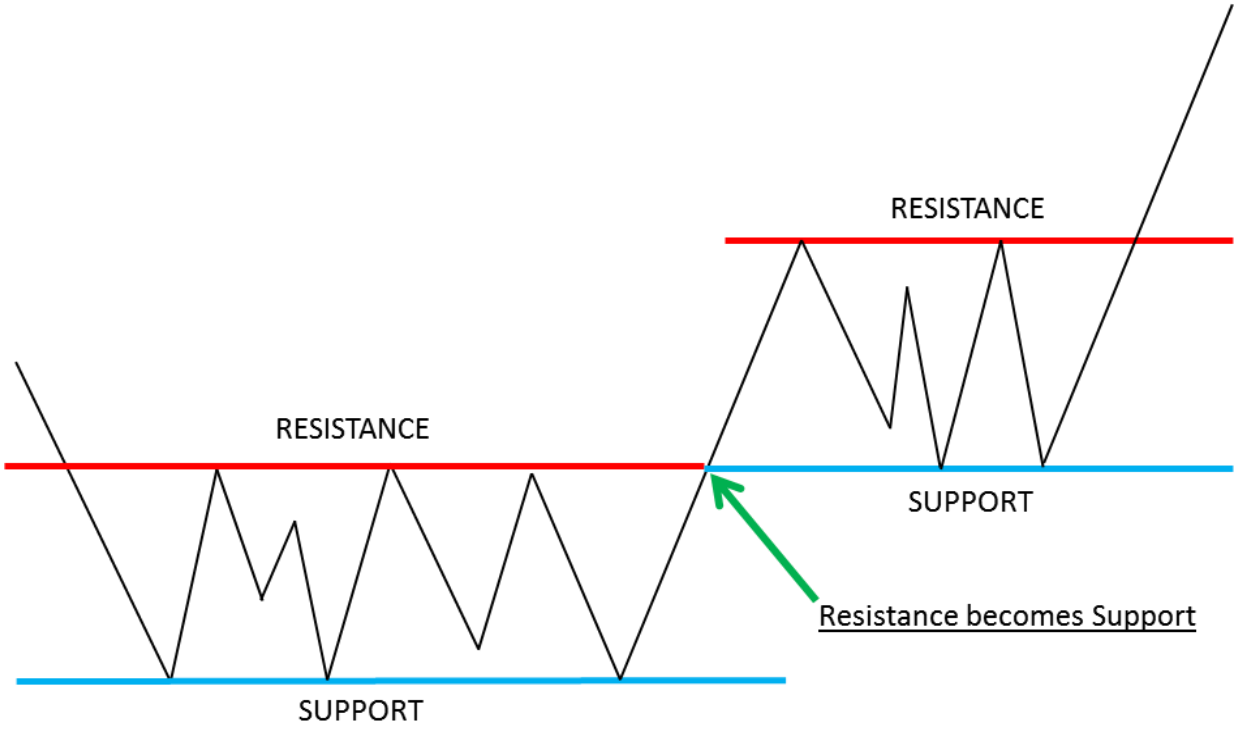

Figure 10: Supports and Resistances

Source: Author's elaboration

3.3.5 Trend

The technical analysis, is based on the concept that market movements are not random and unpredictable: they follow tendencies identifiable by the analyst [Fama E., 1995].

Charles Dow, the father of the Dow Jones, the important market index of the Us Capital Market, in the end of the 19th century, began to study securities prices' trends, formulating a theory that is the basis of the modern technical analysis. He compared stock market movement with ocean's tide movement and he observed the trend, setting a stick in the sand. Initially the stick was reached only by incoming waves and not by the tide. Finally, after its maximum, the tide

receded and so on continuously. This is a phenomena that well explains the price trend in stock markets [Hamilton W. P., 1922].

Tide, like financial markets, is a sequence of phases with an upward trend (characterized by growing maximums and minimums), followed by downward trend (marked by decreasing maximums and minimums). Mr Dow identified three different types of trend:

- Major trend, that leads the market for years;
- Medium trend, observable in the markets for few months;
- Minor trend, constant only for a period lower than a month.

The major trend can be associates to the tide, the medium to the waves and the minor trend to the breakers of the waves. All the described typologies, are connected to each other. The three different trends defined by Dow are applicable also in intra-day trading, scaling the time period of each trend (passing from a day or more to an hour or a minute).

The investor has to operate in the same market's direction of the main trend to gain money, resisting from the temptation to go against the trend by playing on small movement in the opposite direction.

The trend is observable in the market by a so called trend-line, which connects two or more maximums or minimums in the plot. The downward trend is composed by two or more decreasing maximums; vice-versa, an upward trend is defined by two or more growing minimums.

The trend-line provides a more clear and strong indication about the market movement when the number of maximums and minimums considered increases.

A trend is intact till the presence of clear signals of inversion (the most clear is in the breakage of the trend-line). A trend, before its divert of direction, can be followed by a phase of lateral market (figure 11), characterized by small volumes traded and the market is neither bullish (increasing trend) nor bearish (decreasing trend); it is therefore fundamental to understand in which situation the market is in.

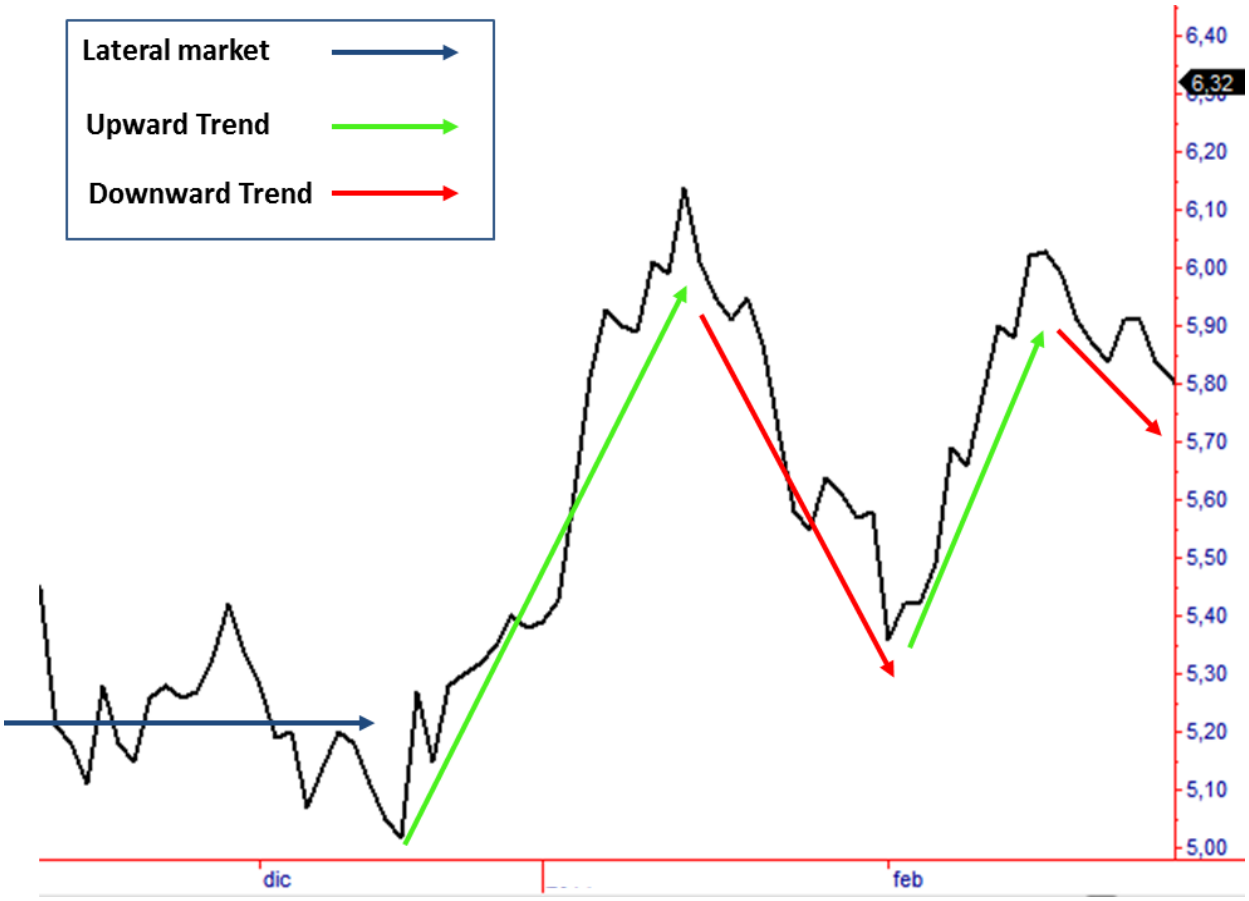

Figure 11: Trend

Source: Author's elaboration

Sometimes, there are false signal of inversion, misleading for investors. Hence, a trend is considered ended when the resistance or the support gets broken and the next test confirm its state change [Fong S., Tai J., Whar S. Y., 2011].

It is possible to trade either during the lateral phase and when the market is in a trend. In the first case, a high level of experience in the stock markets is preferred, because false signals of trend's inversion are frequent; as soon as the market acquires a defined direction, entering in a trend phase, the volumes traded increase and the investor's strategy has to be changed and adapted to the new market conditions.

Generally, how Dow Jones stated, [Murphy J., 1999], trends in financial markets are divided in a sequence of three phases:

- Accumulation, in which smart moneys (investment banks, financial companies, governments and central banks) purchase security against market's tendency, at very convenient prices;
- Participation, where minor and more prudent investors reacquire market's trust, coming in the market again;
- Distribution, in which smart money start to sell securities purchased in the accumulation phase, gaining money, considering the higher securities' price reached respect the one in the accumulation stage, when the financial instruments have been bought.

Usually, in financial markets, the phase of distribution is followed by the stage of accumulation, that coincides with the beginning of a new cycle, as shown in figure 12.

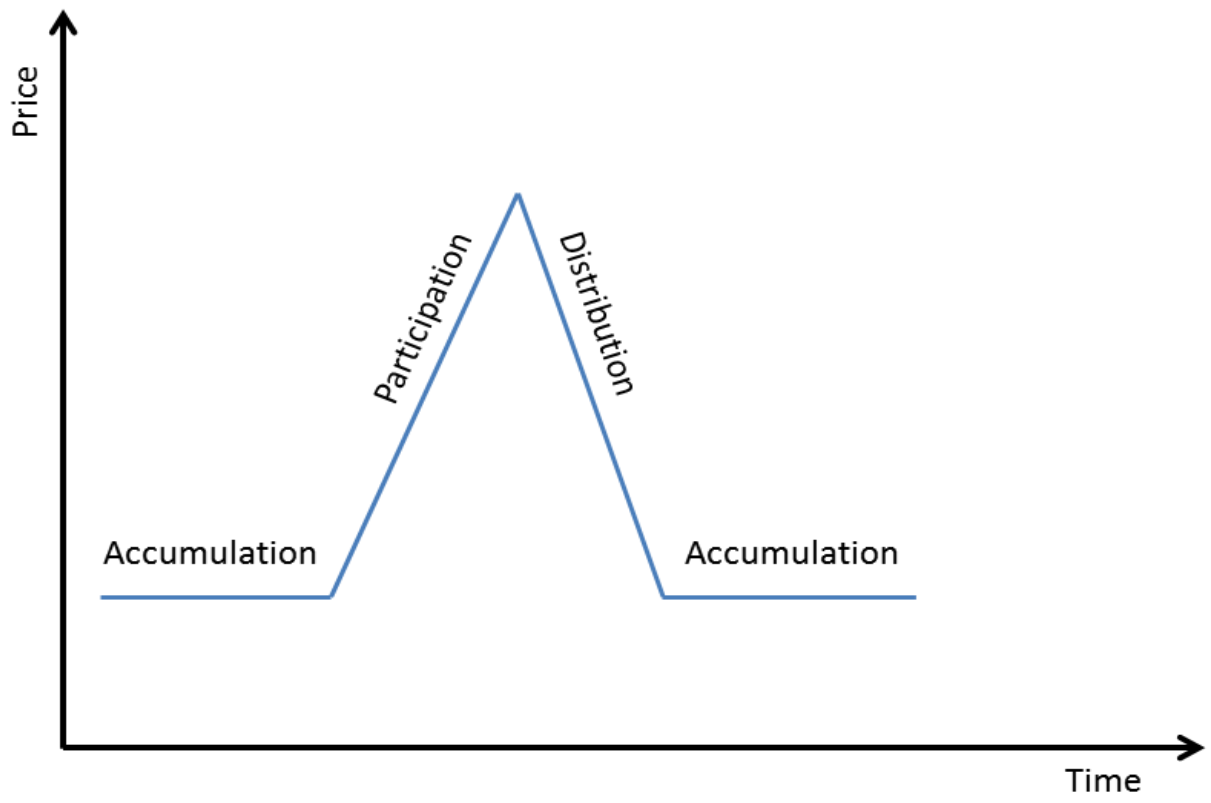

Figure 12: The Trend: Accumulation, Participation and Distribution

Source: Author's elaboration

3.3.6 Volumes

In listed markets the traded volumes are available for investors; the analysis of their level and of their dynamics is important in conjunction with the breakage of supports or resistances. When these events happen with increasing volumes, it is a confirmation of the signal generated, indeed, when volumes are very low, the signal is very light, like it is possible to see in figure 13. Generally, high volumes, confirm the price movement, vice-versa, low volumes, increase the possibility of false signals, because in the first case there is a huge participation of investors, indeed, in the second one there is a lack of interest by the market.

Moreover, a decrease of the volumes traded during a trend, advices investors about the very likely close inversion of the trend.

During the phases in which the market is lateral, volumes traded are low, till the begin of a new trend phase.

It often happens that volumes are higher than average in very important trading session, like for example in proximity of important trend change points. This happens because people "informed" on what it is going to happen have the money, and this means also the power, to make things happen. So, high volumes suggest that operators are buying and selling for a good reason; generally, showing up a maximum, a minimum or the breakage of a support or resistance [Aboody D., Baruch L., 2000].

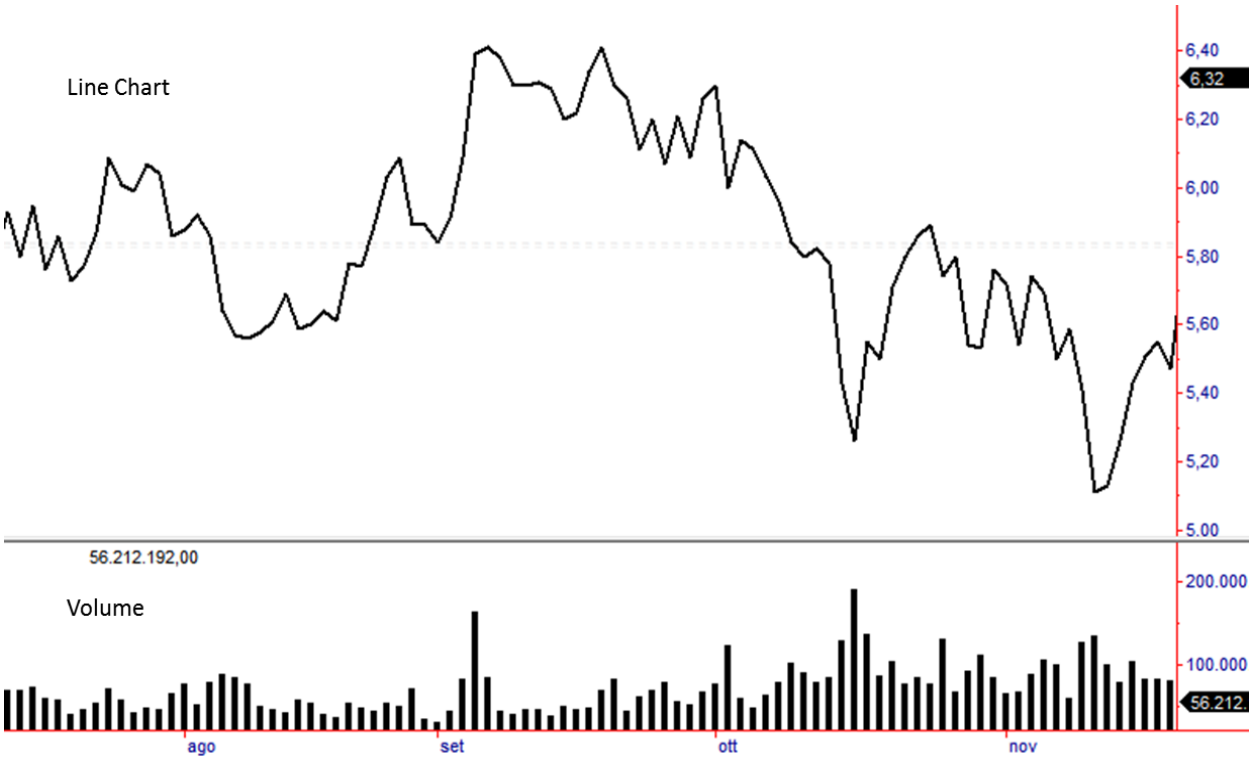

Figure 13: Supports and Resistances

Source: Author's elaboration

3.4 Technical Indicators

Technical indicators, are statistical and mathematical instruments, that allow analysts to catch explicative information in the price's chart, about market movements.

It is necessary to make a clarification about indicators and oscillators:

- Indicators, are instruments without a predefined range and they tend to fluctuate without maximum and minimum values;
- Oscillators, are instruments that assume values inside a defined range.

The main function of technical indicators is to show traders possible points of trend's inversion, determining the strength of a trend, determining variation in exchanged volumes, with lines, points, or bars using also different colours, in a blank plot or on the price's graph [Fang J., Qin Y., Jacobsen B., 2014].

Nowadays, a long list of technical indicators is available, suited for each type of circumstance. In addition, analysts continue to develop new and more precise indicators.

It is essential to deeply know the indicators or oscillators that are employed in the trading session in order to prevent false signals; in fact, the information provided by indicators are not infallible: this risk increases when indicators do not work in the proper context. For this same purpose, it is common to adopt in trading more than one indicator, in order to increase efficacy and precision, reducing the possibility of incorrect signals [Blume L., Easley D., O'Hara M., 1994].

3.5 Which is the Best Solution?

There is not a preferred investment analysis, both fundamental and technical analysis provide appreciable results, if applied correctly.

Fundamental analysis takes long time to evaluate all the aspects necessary to formulate a fair price for a security, but, at the same time, allows to forecast the future price movements. Furthermore, it is very complicated and for this reason rarely a trading system works using the results of fundamental analysis. This analysis allows investors, to select stocks that should raise on the mid-long term, in fact, it is not adapt for intraday trading, or investment in a short period of time, since most times the market would change before the analysis is concluded.

On the other side, technical analysis studies the price in a chart; because it includes all the information about a security, this analysis is not able to forecast the market, while it shows delayed results. The purpose is to show investors the right moment to buy and sell in short-term investments. It has the advantage to be very easy and quick and provides appreciable results; for these reasons it is at the basis of each trading system.

Often, there are conflicts between technical and fundamental analysts, due to the different assumptions at the basis of either methods. For example, usually, the fundamental analyst doesn’t agree with the fact that price includes all the information available, indeed, pure technical analysts observes exclusively the price chart.

In any case, a combination of these two technique is very effective and can provide better results than applying only one of the two methods.

4 Analysis of the Volumes

4.1 Background

The observation of the securities' volumes exchanged in financial markets, focusing on bulls' and bears' (common names for buy and sell side in the market [Gonzales L., Hoan P., Massey G. J., Shi J., 2006] strength, permits to understand the market's direction. Thanks to this information, the trader is informed about market conditions and he can evaluate if it is a good moment to exchange securities gaining money.
This chapter will present an analysis aiming to engage in a more in-depth study of, and to elaborate upon, the cumulative volumes of different securities.

In order to do so, the following question should be answered: *are cumulative volumes valid tools to understand the formation of relevant maximums and minimums in the long-run price chart?*

4.2 Data Series

The data adopted for the analysis are the 70 components of the FTSE MIB and Dow Jones;

- FTSE MIB, is the main representative index of the Italian stock market. This index, includes 40 stocks of important, liquid and high capitalized companies, in different sectors, which represent the 80% of the Italian listed companies. The index measures the performance of the securities it includes, considering its dimension and liquidity, and it has the purpose to reproduce the trend of the entire Italian stock market. FTSE MIB bore after the merger of Borsa Italiana and the London Stock Exchange [Borsa Italiana Website, 2015].
  The historical series is related to the period 02 January 1998 to 18 May 2015;
- Dow Jones: is the most famous index of the New York Stock Exchange, that includes only 30 Blue Chips, for this reason, it has lost part of its importance. In fact, nowadays, the Dow Jones is not able to reflect the trend of the whole US market.

Differently from other indexes, the Dow Jones does not consider the capitalization, so the prices of the index components are not weighted by their amount of stocks. [New York Stock exchange Website, 2015]

The data collected are daily volume exchanged and closing prices of each Dow Jones' component. This historical series is related to the period 02 January 1998 to 18 May 2015.

4.3 Software Adopted

The software adopted for the analysis is the suite Multicharts version 9; it is a platform for advanced technical analysis and automated trading, that permits to create professional charts, advanced analysis and to test strategies.

Its programming language allows to create quickly, complex trading systems and indicators, thanks to the sophisticate tools available.

The platform is very flexible, in fact it permits to save and use data collected from disparate data providers.

Multicharts is composed by five different components:

1. Quote Manager: includes all the data necessary for the trading systems' execution. It permits to collect real time data from a data provider, or, to import historical data in different formats;
2. Power Language Editor: is the editor for programming signals, indicators and function. The programming language of this platform is "Easy Language";
3. 3D Optimization: is the instrument for the optimization of the inputs declared in the trading system, in order to find the most appropriate values that guarantee a good final result;
4. Portfolio Trader: permits to test the trading strategy on historical data, to verify the validity of a strategy and to understand if it is able to make money. Each modification of the strategy, or process of optimization, should be followed by a test on historical data, to understand if the changes bring advantages or not;

5. Graphic Interface with tools: allows to see plots of securities' prices, trading systems during their work and indicators. Each parameter is totally customizable in order to satisfy the preferences of the trader.

4.4 Methodology of the Analysis

The aim of this work consists in the formulation of a method to anticipate the market and to follow its trend, observing the exchanged volumes, with the objective of predicting the formation of important maximum and minimum securities' prices in the long run.

The assumption at the basis of this analysis is that smart money has access to information regarding securities and companies before small investors. In this way, it is possible to buy and sell for valid motives. Big investor's strength in these operations usually generates maximums or minimums, or, at least the breakage of important supports or resistances.

In addition, generally institutional investors try to hide their trading strategies, dividing their orders of purchase or sale of huge volumes of securities in more than one day. In fact, a big order in the market modifies expectations on future trends, alerting market participants on something important that is happening and will modify considerably prices in the market [Frey S., Sandas P., 2009].

For this reason, the strategy consists in the construction of an indicator that measures when the differences between the traded volumes in particular moments are conspicuous if compared to the average volumes exchanged.

Following the two methods adopted to construct the indicator are presented in detail:

-Method A.

This first method has the aim to detect when the cumulative volumes' summation of a certain number of days, represented with the variable *cumsum*, is higher or equal to the variable *avgvalue*, that, is the average of the volumes exchanged in a certain number of days (antecedent the accumulation relative to the *cumsum* variable), multiplied by a value, determined by the variable *multiplier*.

When the condition is verified, Multicharts software colours the bars in the plot in red.

The initial part is the signal that analyzes the chart, calculating when the value of the variable *cumsun* is higher or equal to the value of the variable *avgvalue,* multiplied by the *multiplier*.

The key word *volume* provides the value of the volumes exchanged on a day.

The function *print* allows to see in the monitor the values of the variables *cumsum* and *avg value*, only when the condition is verified, for each time frame.

The analysis starts with an accumulation of the volumes for 3 days, starting on the current day and going back for 2 days (variable *cumsum*); indeed, the average of the volumes traded, is calculated on the same number of days considered in the variable *cumsum*, but the period in which the average of the volumes is calculated is antecedent the day in which the accumulation starts.

The time frame considered is from 3 to 15 days, enlarging each time the interval of one unit.

Following the programming language to process the described actions is reported:

```
//Analysis cumulative volumes avg--> Signal

input: multiplier3(5.7), multiplier4(5.35),multiplier5(5), multiplier6(4.65),
multiplier7(4.3), multiplier8(3.95), multiplier9(3.6), multiplier10(3.25),
multiplier11(2.9), multiplier12(2.55), multiplier13(2.2), multiplier14(1.85),
multiplier15(1.5);

var: cumsum3(0), avgvalue3(0), cumsum4(0), avgvalue4(0), cumsum5(0),
avgvalue5(0), cumsum6(0), avgvalue6(0), cumsum7(0), avgvalue7(0), cumsum8(0),
avgvalue8(0), cumsum9(0), avgvalue9(0), cumsum10(0), avgvalue10(0),
cumsum11(0), avgvalue11(0), cumsum12(0), avgvalue12(0), cumsum13(0),
avgvalue13(0), cumsum14(0), avgvalue14(0), cumsum15(0), avgvalue15(0);

//Volumes' accumulation for 3 days
cumsum3= summation(volume,3);
avgvalue3= average(volume[4],3)* multiplier3;
if
cumsum3>= avgvalue3
then
print ("Accumulation=3days", " ", "Date:", date, " ", "Cumulative
Volumes:", cumsum3, " ", "HIGHER than", " ", "Avg Volumes:", avgvalue3);
```

```
//Volumes' accumulation for 4 days
cumsum4= summation(volume,4);
avgvalue4= average(volume[5],4)* multiplier4;
if
cumsum4>= avgvalue4
then
print  ("Accumulation=4days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum4, "  ", "HIGHER than", "  ", "Avg Volumes:", avgvalue4);

//Volumes' accumulation for 5 days
cumsum5= summation(volume,5);
avgvalue5= average(volume[6],5)* multiplier5;
if
cumsum5>= avgvalue5
then
print  ("Accumulation=5days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum5, "  ", "HIGHER than", "  ", "Avg Volumes:", avgvalue5);

//Volumes' accumulation for 6 days
cumsum6= summation(volume,6);
avgvalue6= average(volume[7],6)* multiplier6;
if
cumsum6>= avgvalue6
then
print  ("Accumulation=6days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum6, "  ", "HIGHER than", "  ", "Avg Volumes:", avgvalue6);

//Volumes' accumulation for 7 days
cumsum7= summation(volume,7);
avgvalue7= average(volume[8],7)* multiplier7;
if
cumsum7>= avgvalue7
then
print  ("Accumulation=7days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum7, "  ", "HIGHER than", "  ", "Avg Volumes:", avgvalue7);

//Volumes' accumulation for 8 days
cumsum8= summation(volume,8);
avgvalue8= average(volume[9],8)* multiplier8;
if
cumsum8>= avgvalue8
then
```

```
print  ("Accumulation=8days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum8, "  ", "HIGHER than", "  ", "Avg Volumes:", avgvalue8);

//Volumes' accumulation for 9 days
cumsum9= summation(volume,9);
avgvalue9= average(volume[10],9)* multiplier9;
if
cumsum9>= avgvalue9
then
print  ("Accumulation=9days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum9, "  ", "HIGHER than", "  ", "Avg Volumes:", avgvalue9);

//Volumes' accumulation for 10 days
cumsum10= summation(volume,10);
avgvalue10= average(volume[11],10)* multiplier10;
if
cumsum10>= avgvalue10
then
print  ("Accumulation=10days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum10, "  ", "HIGHER than", "  ", "Avg Volumes:", avgvalue10);

//Volumes' accumulation for 11 days
cumsum11= summation(volume,11);
avgvalue11= average(volume[12],11)* multiplier11;
if
cumsum11>= avgvalue11
then
print  ("Accumulation=11days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum11, "  ", "HIGHER than", "  ", "Avg Volumes:", avgvalue11);

//Volumes' accumulation for 12 days
cumsum12= summation(volume,12);
avgvalue12= average(volume[13],12)* multiplier12;
if
cumsum12>= avgvalue12
then
print  ("Accumulation=12days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum12, "  ", "HIGHER than", "  ", "Avg Volumes:", avgvalue12);

//Volumes' accumulation for 13 days
cumsum13= summation(volume,13);
avgvalue13= average(volume[14],13)* multiplier13;
```

```
if
cumsum13>= avgvalue13
then
print  ("Accumulation=13days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum13, "  ", "HIGHER than", "  ", "Avg Volumes:", avgvalue13);

//Volumes' accumulation for 14 days
cumsum14= summation(volume,14);
avgvalue14= average(volume[15],14)* multiplier14;
if
cumsum14>= avgvalue14
then
print  ("Accumulation=14days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum14, "  ", "HIGHER than", "  ", "Avg Volumes:", avgvalue14);

//Volumes' accumulation for 15 days
cumsum15= summation(volume,15);
avgvalue15= average(volume[16],15)* multiplier15;
if
cumsum15>= avgvalue15
then
print  ("Accumulation=15days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum15, "  ", "HIGHER than", "  ", "Avg Volumes:", avgvalue15);
```

The next step is that the software will show the indicators on the plot when the condition is verified. There is an indicator for each time period of volumes' accumulation (from 3 to 15 days), in order to enlighten only a condition per time, otherwise results would not be easily observable in the chart.

When the condition is true, Multicharts colours the bars of the chart in red, thanks to the function *PlotPaintBar*.

Following the programming language is reported:

```
//Analysis cumulative volumes avg--> Indicator

input: multiplier3(5.7);
```

```
var: cumsum3(0), avgvalue3(0);

//Volumes' accumulation for 3 days
cumsum3= summation(volume,3);
avgvalue3= average (volume[4],3)* multiplier3;
if
cumsum3>= avgvalue3
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes avg--> Indicator

input: multiplier4(5.35);

var: cumsum4(0), avgvalue4(0);

//Volumes' accumulation for 4 days
cumsum4= summation(volume,4);
avgvalue4= average(volume[5],4)* multiplier4;
if
cumsum4>= avgvalue4
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes avg--> Indicator

input: multiplier5(5);

var: cumsum5(0), avgvalue5(0);

//Volumes' accumulation for 5 days
cumsum5= summation(volume,5);
avgvalue5= average (volume[6],5)* multiplier5;
if
cumsum5>= avgvalue5
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes avg--> Indicator
```

```
input: multiplier6(4.65);

var: cumsum6(0), avgvalue6(0);

//Volumes' accumulation for 6 days
cumsum6= summation(volume,6);
avgvalue6= average (volume[7],6)* multiplier6;
if
cumsum6>= avgvalue6
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes avg--> Indicator

input: multiplier7(4.3);

var: cumsum7(0), avgvalue7(0);

//Volumes' accumulation for 7 days
cumsum7= summation(volume,7);
avgvalue7= average (volume[8],7)* multiplier7;
if
cumsum7>= avgvalue7
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes avg--> Indicator

input: multiplier8(3.95);

var: cumsum8(0), avgvalue8(0);

//Volumes' accumulation for 8 days
cumsum8= summation(volume,8);
avgvalue8= average (volume[9],8)* multiplier8;
if
cumsum8>= avgvalue8
then
PlotPaintBar(High,Low,Open,Close);
```

```
//Analysis cumulative volumes avg--> Indicator

input: multiplier9(3.6);

var: cumsum9(0), avgvalue9(0);

//Volumes' accumulation for 9 days
cumsum9= summation(volume,9);
avgvalue9= average (volume[10],9)* multiplier9;
if
cumsum9>= avgvalue9
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes avg--> Indicator

input: multiplier10(3.25);

var: cumsum10(0), avgvalue10(0);

//Volumes' accumulation for 10 days
cumsum10= summation(volume,10);
avgvalue10= average (volume[11],10)* multiplier10;
if
cumsum10>= avgvalue10
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes avg--> Indicator

input: multiplier11(2.9);

var: cumsum11(0), avgvalue11(0);

//Volumes' accumulation for 11 days
cumsum11= summation(volume,11);
avgvalue11= average (volume[12],11)* multiplier11;
if
```

```
cumsum11>= avgvalue11
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes avg--> Indicator

input: multiplier12(2.55);

var: cumsum12(0), avgvalue12(0);

//Volumes' accumulation for 12 days
cumsum12= summation(volume,12);
avgvalue12= average (volume[13],12)* multiplier12;
if
cumsum12>= avgvalue12
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes avg--> Indicator

input: multiplier13(2.2);

var: cumsum13(0), avgvalue13(0);

//Volumes' accumulation for 13 days
cumsum13= summation(volume,13);
avgvalue13= average (volume[14],13)* multiplier13;
if
cumsum13>= avgvalue13
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes avg--> Indicator

input: multiplier14(1.85);

var: cumsum14(0), avgvalue14(0);

//Volumes' accumulation for 14 days
```

```
cumsum14= summation(volume,14);
avgvalue14= average (volume[15],14)* multiplier14;
if
cumsum14>= avgvalue14
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes avg--> Indicator

input: multiplier15(1.5);

var: cumsum15(0), avgvalue15(0);

//Volumes' accumulation for 15 days
cumsum15= summation(volume,15);
avgvalue15= average (volume[16],15)* multiplier15;
if
cumsum15>= avgvalue15
then
PlotPaintBar(High,Low,Open,Close);
```

-Method B.

The second method adopted is less complex than the one just explained and it does not require the multiplier, which is an arbitrary parameter difficult to be calculated. For this reason, this second technique is based only on the comparison between the cumulative volumes' summation of a certain number of days, represented with the variable *cumsum* and the variable *pastsum*, for the accumulation of the volumes exchanged in a certain number of days (antecedent the accumulation that regards the *cumsum* variable).

The interesting days are those in which the variable *cumsum* is higher or equal to the variable *pastsum.* When this condition is verified, the bars in the chart assume the colour red.

At the beginning of the programming language there is the signal that interprets the chart, it calculates when the value of the variable *cumsun* is higher or equal to the value of the variable *pastsum*.

The key word *volume* provides the value of the volumes exchanged on a day.

The function *print* allows to see on the monitor the values of the variables *cumsum* and *pastsum*, only when the condition is verified, for each time frame.

Also in this case, the analysis starts with an accumulation of the volumes for 3 days, starting from 2 days before the current day (variable *cumsum*); indeed, the variable *pastsum* is the accumulation of the volumes for 23 days, but the period in which this second volumes' accumulation is calculated is antecedent to the day in which the accumulation of the volumes that interests the variable *cumsum* starts.

The considered time-frames are the interval from 3 to 10 days, enlarging each time the interval of one unit, for the variable *cumsum*, indeed, for the variable *pastsum*, the interval is from 20 to 41 days respectively, increasing of 3 units each time the variable *cumsum* is increased of one unit.

Following the developed programming language is shown:

```
//Analysis cumulative volumes sum--> Signal

var:   cumsum3(0),   pastsum20(0),   cumsum4(0),   pastsum23(0),   cumsum5(0),
pastsum26(0), cumsum6(0), pastsum29(0), cumsum7(0), pastsum32(0), cumsum8(0),
pastsum35(0), cumsum9(0), pastsum38(0), cumsum10(0), pastsum41(0);

//Volumes' accumulation for 3 days
cumsum3= summation(volume,3);
pastsum20= summation(volume[4],20);
if
cumsum3>= pastsum20
then
print  ("Accumulation=3days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum3, "  ", "HIGHER than", "  ", "Avg Volumes:", pastsum20);

//Volumes' accumulation for 4 days
cumsum4= summation(volume,4);
pastsum23= summation(volume[5],23);
if
cumsum4>= pastsum23
then
```

```
print  ("Accumulation=3days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum4, "  ", "HIGHER than", "  ", "Avg Volumes:", pastsum23);

//Volumes' accumulation for 5 days
cumsum5= summation(volume,5);
pastsum26= summation(volume[6],26);
if
cumsum5>= pastsum26
then
print  ("Accumulation=3days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum5, "  ", "HIGHER than", "  ", "Avg Volumes:", pastsum26);

//Volumes' accumulation for 6 days
cumsum6= summation(volume,6);
pastsum29= summation(volume[7],29);
if
cumsum6>= pastsum29
then
print  ("Accumulation=3days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum6, "  ", "HIGHER than", "  ", "Avg Volumes:", pastsum29);

//Volumes' accumulation for 7 days
cumsum7= summation(volume,7);
pastsum32= summation(volume[8],32);
if
cumsum7>= pastsum32
then
print  ("Accumulation=3days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum7, "  ", "HIGHER than", "  ", "Avg Volumes:", pastsum32);

//Volumes' accumulation for 8 days
cumsum8= summation(volume,8);
pastsum35= summation(volume[9],35);
if
cumsum8>= pastsum35
then
print  ("Accumulation=3days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum8, "  ", "HIGHER than", "  ", "Avg Volumes:", pastsum35);

//Volumes' accumulation for 9 days
cumsum9= summation(volume,9);
pastsum38= summation(volume[10],38);
```

```
if
cumsum9>= pastsum38
then
print  ("Accumulation=3days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum9, "  ", "HIGHER than", "  ", "Avg Volumes:", pastsum38);

//Volumes' accumulation for 10 days
cumsum10= summation(volume,10);
pastsum41= summation(volume[11],41);
if
cumsum10>= pastsum41
then
print  ("Accumulation=3days",  "    ",  "Date:",  date,  "    ",  "Cumulative
Volumes:", cumsum10, "  ", "HIGHER than", "  ", "Avg Volumes:", pastsum41);
```

The next step is to use the programming language of the indicators, that show in the plot when the condition is verified. There is an indicator for each time period of volumes' accumulation, from 3 to 10 days for the variable *cumsum*, and from 20 to 41 days for the variable *pastsum*, respectively (since each unit's increment of the variable *cumsum*, corresponds to an increment of 3 units of the variable pastsum).

In this way, only a condition per time can be enlighten, otherwise, results are not easily observable in the chart.

When the condition is true, Multicharts colours the bars of the chart in red, thanks to the function *PlotPaintBar*.

Following the programming language is reported:

```
//Analysis cumulative volumes sum--> Indicator

var: cumsum3(0), pastsum20(0);

//Volumes' accumulation for 3 days
cumsum3= summation(volume,3);
pastsum20= summation(volume[4],20);
if
cumsum3>= pastsum20
```

```
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes sum--> Indicator

var: cumsum4(0), pastsum23(0);

//Volumes' accumulation for 4 days
cumsum4= summation(volume,4);
pastsum23= summation(volume[5],23);
if
cumsum4>= pastsum23
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes sum--> Indicator

var: cumsum5(0), pastsum26(0);

//Volumes' accumulation for 5 days
cumsum5= summation(volume,5);
pastsum26= summation(volume[6],26);
if
cumsum5>= pastsum26
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes sum--> Indicator

var: cumsum6(0), pastsum29(0);

//Volumes' accumulation for 6 days
cumsum6= summation(volume,6);
pastsum29= summation(volume[7],29);
if
cumsum6>= pastsum29
then
PlotPaintBar(High,Low,Open,Close);
```

```
//Analysis cumulative volumes sum--> Indicator

var: cumsum7(0), pastsum32(0);

//Volumes' accumulation for 7 days
cumsum7= summation(volume,7);
pastsum32= summation(volume[8],32);
if
cumsum7>= pastsum32
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes sum--> Indicator

var: cumsum8(0), pastsum35(0);

//Volumes' accumulation for 8 days
cumsum8= summation(volume,8);
pastsum35= summation(volume[9],35);
if
cumsum8>= pastsum35
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes sum--> Indicator

var: cumsum9(0), pastsum38(0);

//Volumes' accumulation for 9 days
cumsum9= summation(volume,9);
pastsum38= summation(volume[10],38);
if
cumsum9>= pastsum38
then
PlotPaintBar(High,Low,Open,Close);


//Analysis cumulative volumes sum--> Indicator
```

```
var: cumsum10(0), pastsum41(0);

//Volumes' accumulation for 10 days
cumsum10= summation(volume,10);
pastsum41= summation(volume[11],41);
if
cumsum10>= pastsum41
then
PlotPaintBar(High,Low,Open,Close);
```

4.5 Main Results

Some of the developed indicators produced satisfying results, others were less precise and so considered not appropriate to be used in a trading system, in order to avoid to lose money. Another group included indicators not able to provide useful information because the condition at the basis of the indicator was always, or, never verified (the plot is red or black respectively, in all its extension).

Following, the tree categories of plots regarding the different grades of reliability in the prediction of the future market movement analysing the cumulative volumes are shown:

- Good indicators:

  The indicators showed in figures 14, 15, 16 and 17 predict well the formation of maximums and minimums in the market (the red bar means the condition at the basis of the indicator is true).

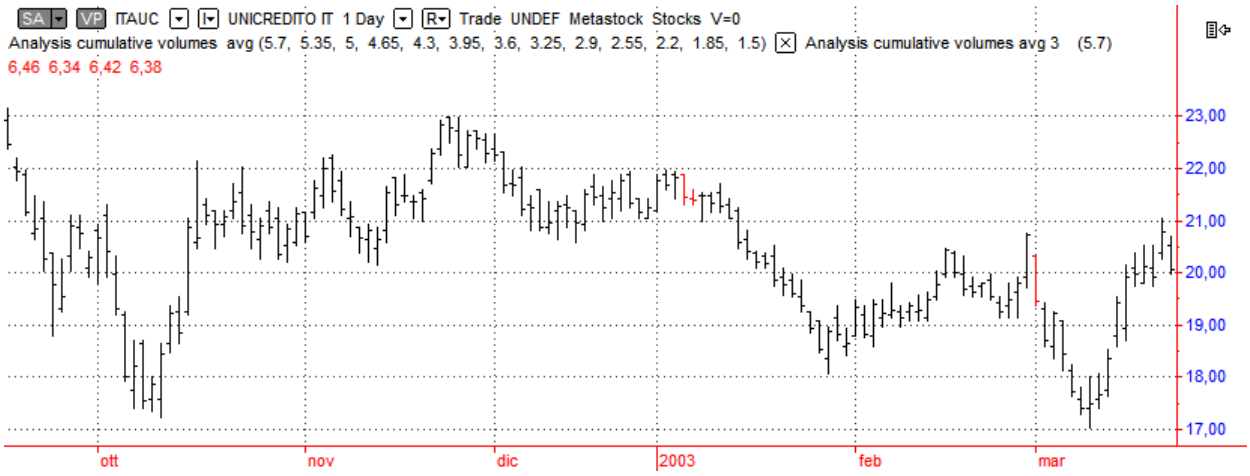

Figure 14: Unicredito Bar Chart + First Method 3 Days

Source: Author's elaboration

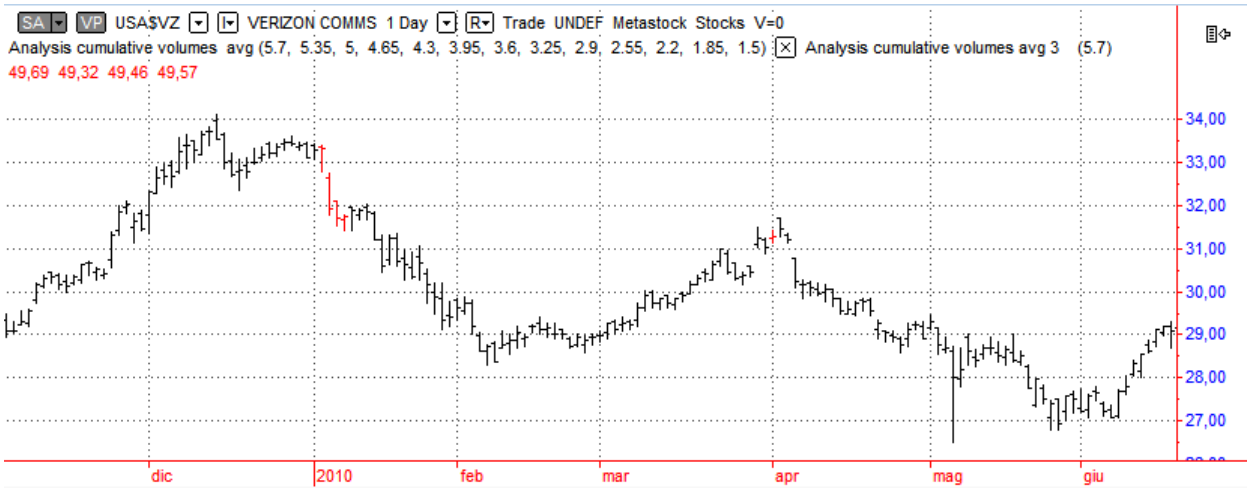

Figure 15: Verizon Bar Chart + First Method 3 Days

Source: Author's elaboration

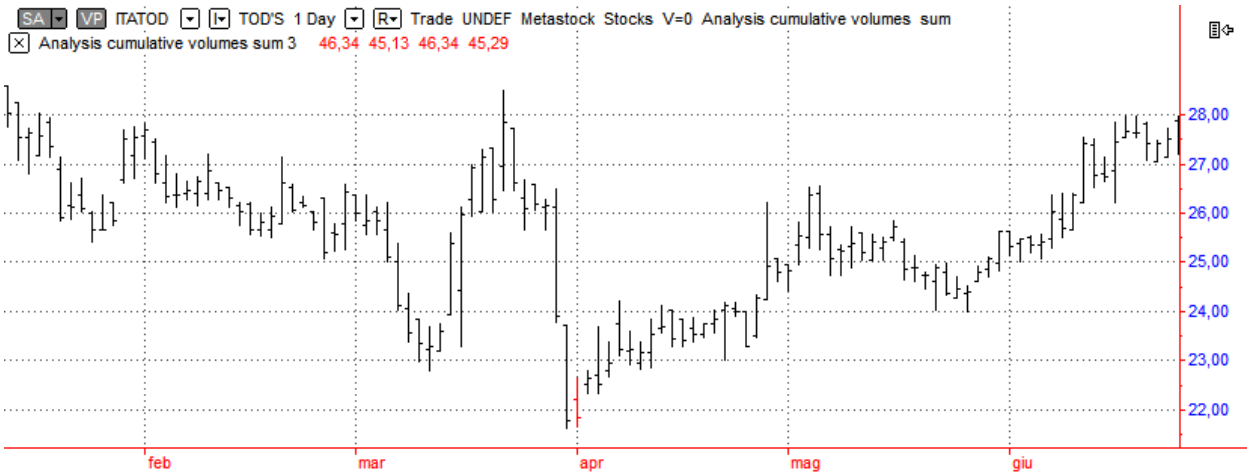

Figure 16: Tod's Bar Chart + Second Method 3 Days

Source: Author's elaboration

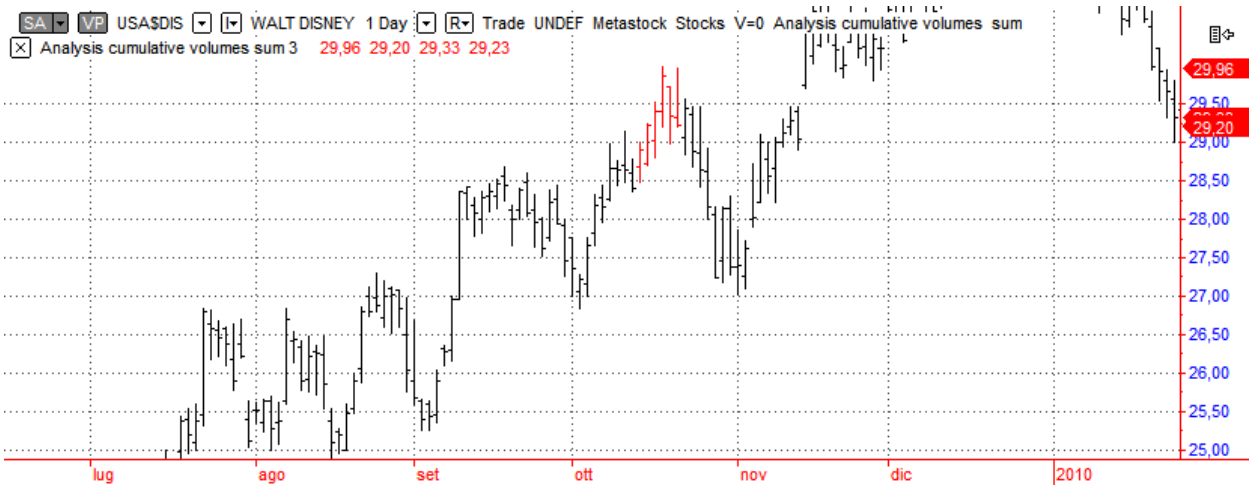

Figure 17: Walt Disney Bar Chart + Second Method 3 Days

Source: Author's elaboration

- Not very precise indicators:

Indicators in figures 18, 19, 20 and 21 are not very useful to predict the market, in fact, the major part of the bars are red; not only in the proximity of maximums and minimums.

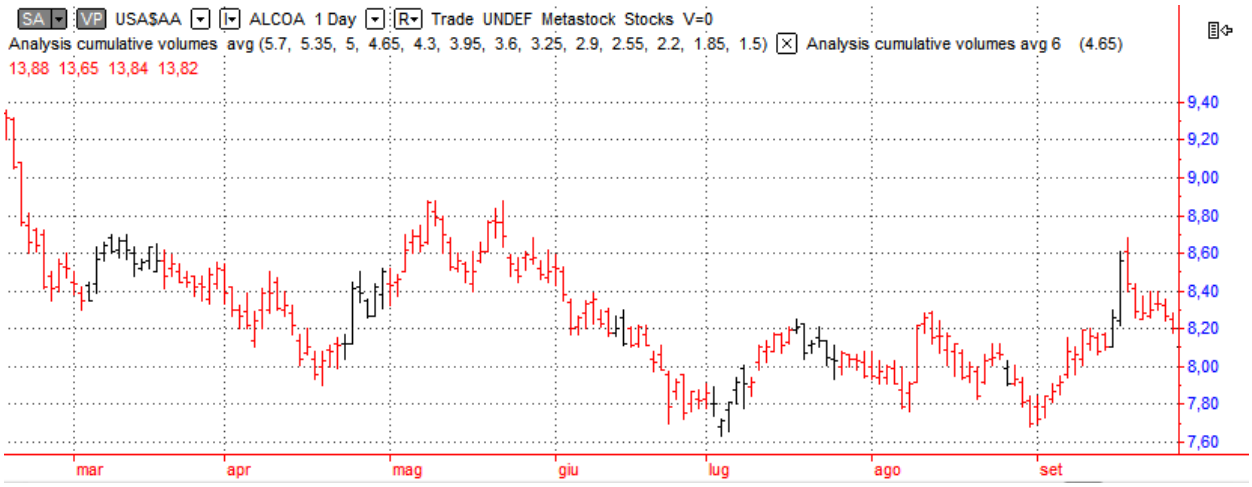

Figure 18: Alcoa Bar Chart + First Method 6 Days

Source: Author's elaboration

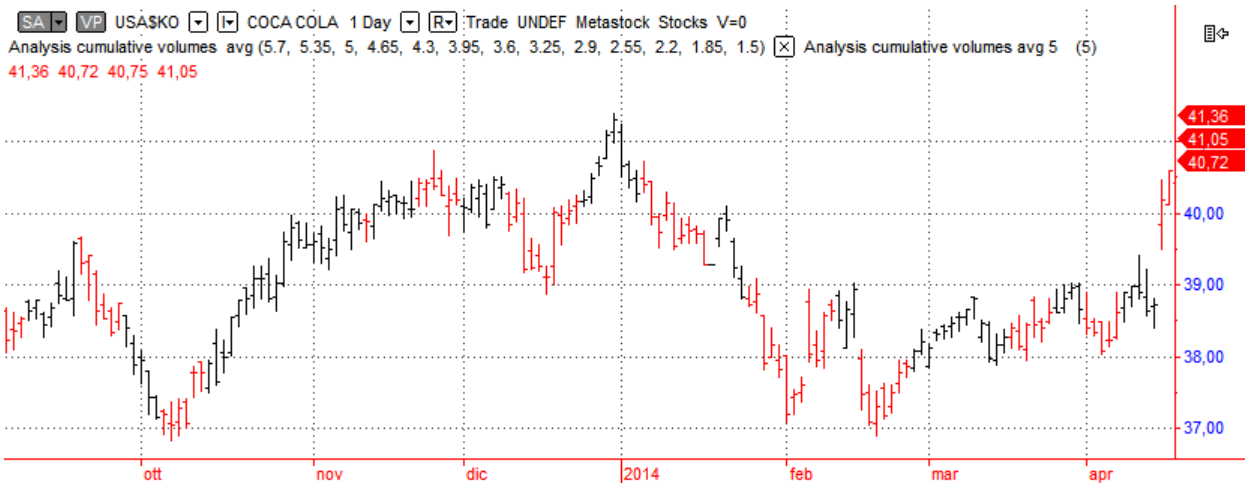

Figure 19: Coca Cola Bar Chart + First Method 5 Days

Source: Author's elaboration

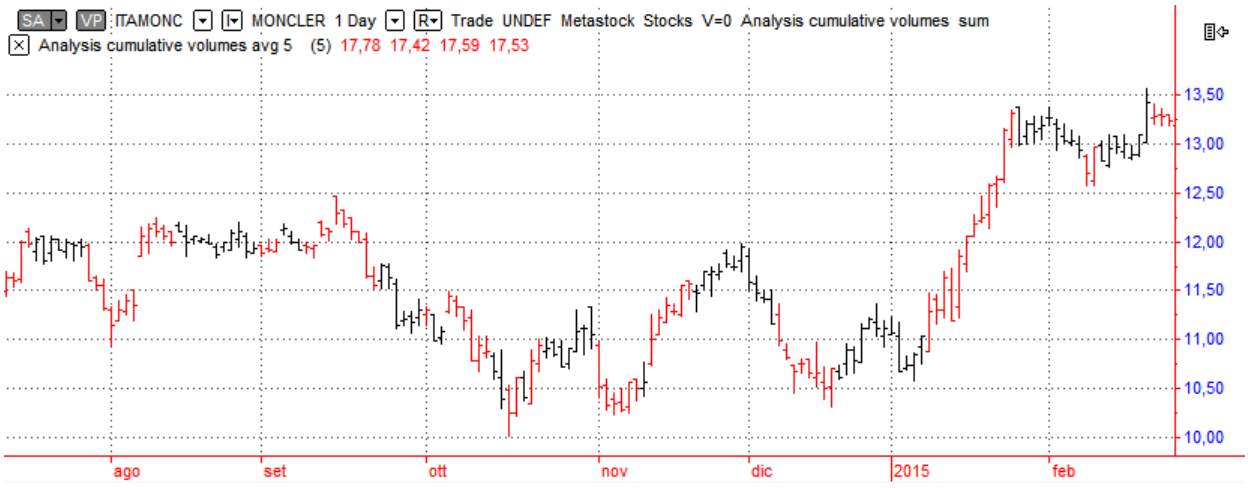

Figure 20: Moncler Bar Chart + Second Method 5 Days

Source: Author's elaboration

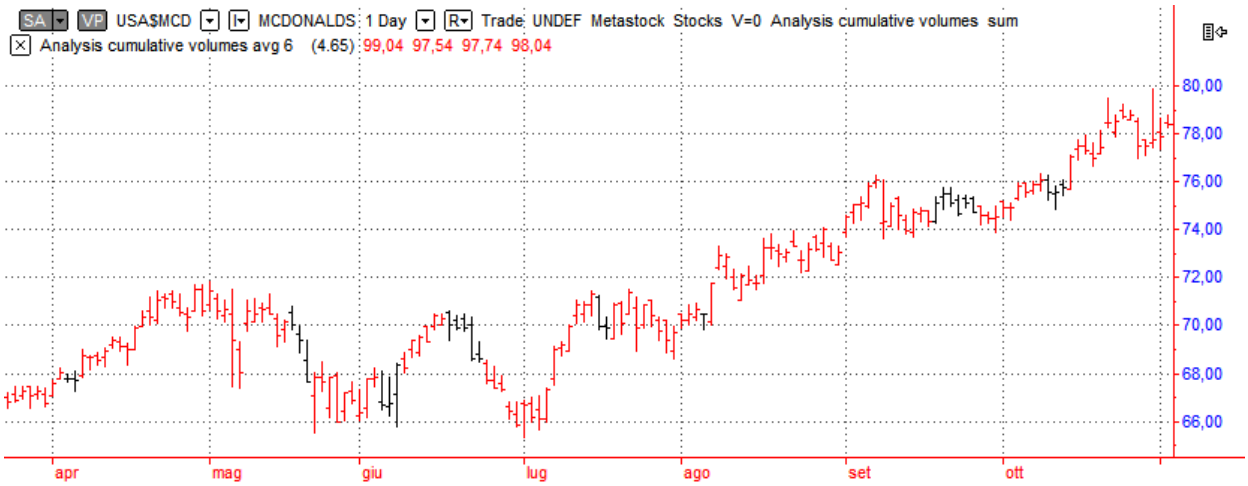

Figure 21: Mcdonald's Bar Chart + Second Method 6 Days

Source: Author's elaboration

- Meaningless indicators:

Figures 22, and 23 illustrate not useful indicators, because every bar is red; indeed, in figures 24 and 25 every bar is black. These four graphs do not provide signals about the future market trend.

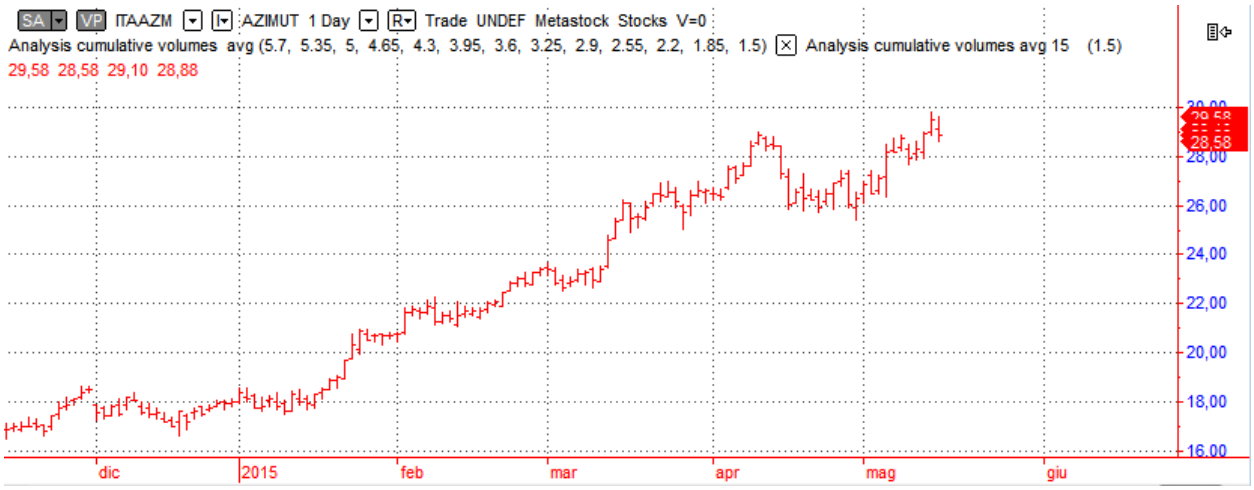

Figure 22: Azimut Bar Chart + First Method 15 Days

Source: Author's elaboration

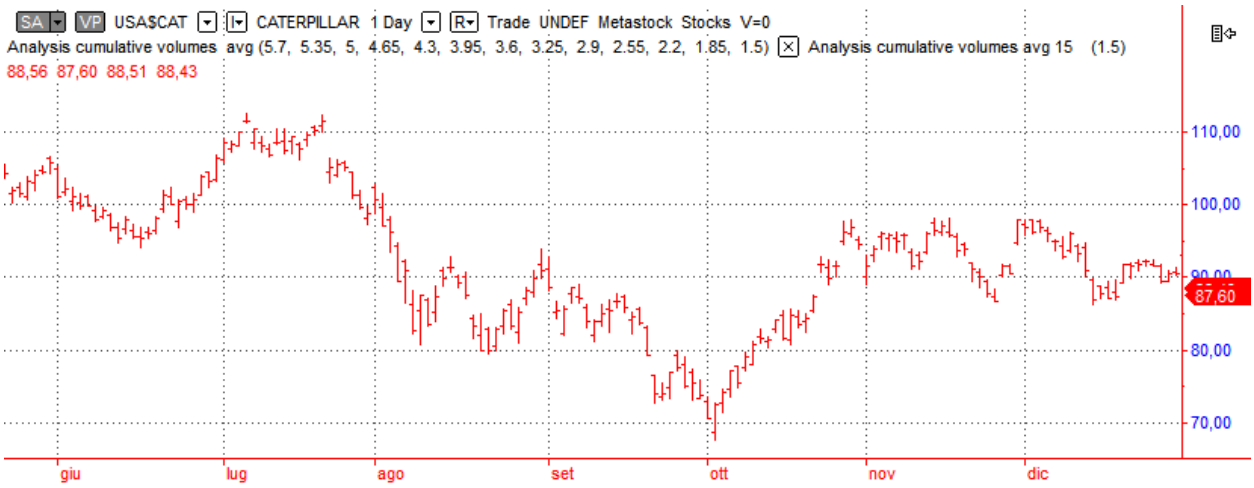

Figure 23: Caterpillar Bar Chart + First Method 15 Days

Source: Author's elaboration

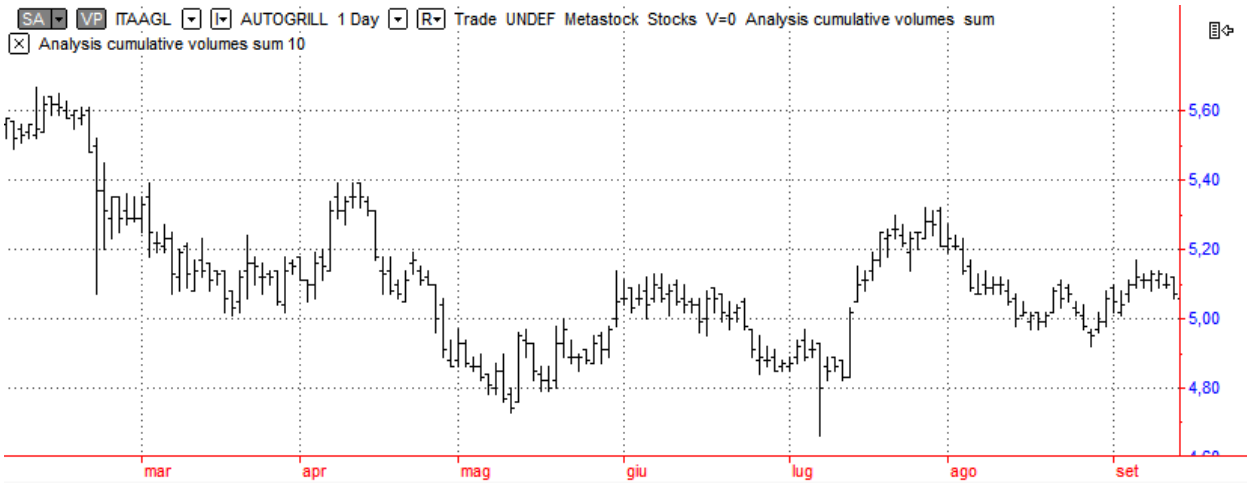

Figure 24: Autogrill Bar Chart + Second Method 10 Days

Source: Author's elaboration

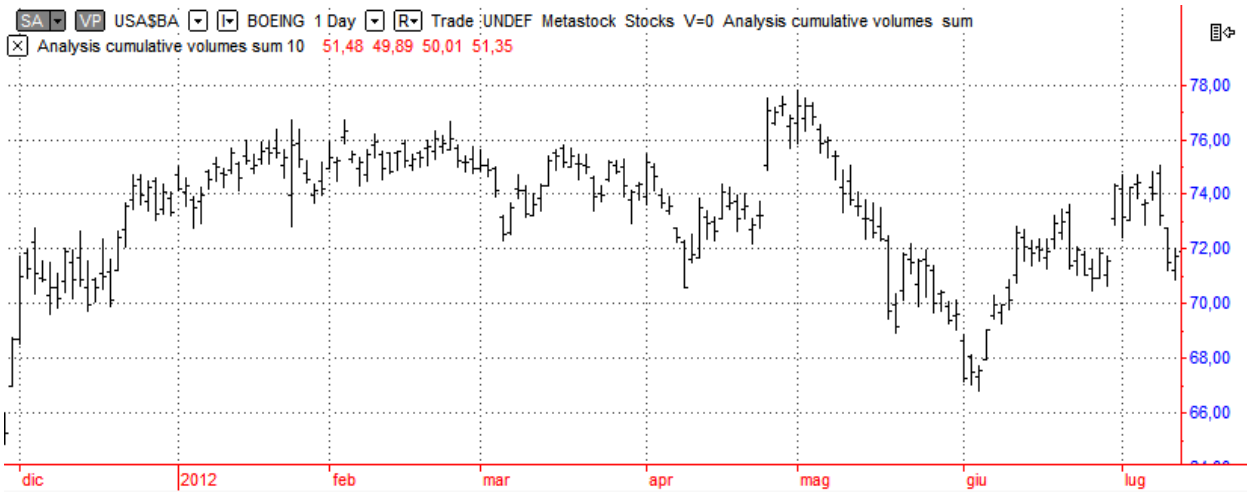

Figure 25: Boeing Bar Chart + Second Method 10 Days

Source: Author's elaboration

4.6 Discussion

4.6.1 Comment of Results, Problems and Resolutions

The results obtained in the analysis are the final stage of a long process necessary to select the most proper values for the parameters, in particular, the length of the time frame of the following variables: *cumsum*, *avgvalue*, *pastsum* and *multiplier.* The objective is to achieve interesting signals that suggest the formulation of an important maximum and minimum in the price chart, on a consistent number of stocks, part of the Dow Jones and FTSE MIB Indices.

Initially, the study consisted in only one method, precisely the first illustrated (method A.), which contains the variable *multiplier*, an arbitrary parameter, determined through several tests. The values adopted and illustrated in the analysis for the parameters *multiplier* are those that give back the better results in term of market prediction.

The second method of analysis (method B) has been added to eliminate possible errors deriving from the choice of a not exact value for the parameters *multiplier* and to increase the precision of the indicators.

Results belie the intuition, in fact, adopting the second method, despite the consistent number of experiments done to optimize the values of the time frame in which volumes are accumulate, the forecasts are not very reliable for the totality of the stocks included in the indices. Furthermore, method B, compared to method A, provides results less satisfying in the forecast of the market.

In relation to the plots of the indicators developed, it is possible to state that the most accurate forecasts are those with the lower time frame for the volumes accumulation; but the best indicator is related to the first method of analysis, with a time frame of 3 days and a *multiplier* factor equal to 5.7.

When the time frame selected increases, the precision of the forecasts decreases. With the higher time frame considered for the accumulation of the volumes, the indicators do not provide useful information about the market, because, in these cases, the condition at the basis of the indicators, are always true using method A of analysis (the bars of the chart are all red) indeed, applying method B, the condition results always false (the bars of the chart are all black).

Before arriving to the presented set of the parameters many changes in the strategies have been done, two in particular are important to be noticed: in a first phase, the strategy, in both methods, accumulated volumes going back from the last day, in a second phase, volumes were accumulated from the current day. Results shows this second experiment was more accurate. The other change is related to the period of accumulation, the average of the volumes in the first methodology and the sum of the past volumes of the second case. At the beginning, the periods were overlapping, but, the tests and the observation of the plots helped to improve the strategy, separating the two phases for the calculus of the volumes, leaving an interval of a day. This little change permitted to increase considerably the efficiency of the system, this progress has allowed to obtain a more clear and accurate forecast of the important maximum and minimum security prices in the long-run.

4.6.2 Evolution of the Analysis

This work can be considered the starting point for the construction of a trading system that invests in different financial instruments.

Once the indicators suggest correctly the future formation of maximums and minimums analysing volumes traded, the major part of the work is completed. In fact, it is necessary that the system buys or sells short securities in relation with the current trend, when the phase of accumulation is concluded, exactly at the second bar of the security bar chart, when the set up criteria is no longer met; more precisely at the second bar because it is a double confirmation that the accumulation phase is concludes. In addition, all the decisions have to be based on a rigorous method of money management and the rules mentioned in the previous chapters should be respected.

A good way to close the open position, either when it is profitable and in loss, can be a trailing stop; in this context it acts simultaneously as stop loss (when the position is losing money) and as take profit (when the position is in gain). The trailing stop consists in a continue change of the level at which the position is closed [Iglehart, D. L., 1995]. A solution for a trailing stop can be determined by closing the position when the current price of the adopted financial instrument is lower than its minimum price of the last three days, in order to take profit from all the trend, when a long position is opened; vice-versa, in case of short selling, the position

will be closed when the security's current price is higher than its average [maximum] price of the last three days.

In this way, the strategy is to buy or sell short before the formation of an important maximum or minimum and to keep the position open till the inversion of the trend, thanks to the trailing stop. Obviously, all the inputs have to be optimized and the strategy back tested many times, in order to be improved and to find the best set up of all the components.

Hence, it is strongly suggested to back-test the strategy till it reaches satisfying results in terms of profitability, before adopting it in the market with real time data and investing real money.

4.6.3 Other Experts' Opinions

The general debate about the study of the volumes exchanged to forecast financial markets, shows that there is a common opinion about its advantages.

Many experts believe that the observation of the volumes exchanged in financial markets is a valid instrument of technical analysis, together with other important indicators. In fact, the high volumes increase the strength of market signals, suggesting when they are true market movements, or only false signals.

The combination of more than one technical indicator with the study of the volumes has been adopted also in the past: the intuition that volumes' interpretation was a good source of information for future market movement, furthermore, was the basic concept of Epps and Eppis' work about the stochastic dependence of security price changes and transaction volumes in the far 1976 [Epps T. W., Eppis M. L., 1976].

The relation of prices and volumes has been studied also by Rogalsi in 1978. The conclusion of his study is that volumes' changes help to forecast the price variation in both "bull" and "bear" markets [Rogalsi R. J., 1978].

More recently, the importance of volumes traded has been studied by many researchers. An important contribution arrives from the work of Gllent, Rosi and Tauchen in 1992, in which they conclude that price changes lead to volume movements. The effect is directly proportional; large price declines are together with volume declines and vice-versa [Gllent A. R., Rossi P. E., Tauchen G., 1992].

Another important contribution comes by Campbell, Grossman and Wang in 1993: their model developed during the analysis, observed that a stock price decreases on a high-volume day, is more likely, than a stock price decline on a low-volume day; every important movement in the market is confirmed by high volumes exchanged [Campbell J. Y., Grossman J., and Jiang W., 1993].

Also in the 3rd millennium the argument has risen interests and the research in this field continues, Lokman and Abdulnasser for example, in their work show the relation between stock prices and volumes in emerging markets [Lokman G., Abdulnasser H. J., 2005].

Conclusions

The observation of cumulative volumes provides interesting and useful information about the market; for this reason, the argument has captured the attention of many researchers. The strong relation between the prices of financial instruments and volumes traded provides an overview of the phase in which the market is in and also can be used for forecast purpose, like the analysis of the chapter four shows.

The indicators developed are very useful to forecast the formation of important maximums and minimums, in particular, the indicator with the best set of parameters found with the several tests permits to understand in advance when the formation of a maximum or a minimum in the market is close. Hence, a trading system that adopts the indicator developed can be programmed, taking advantage from the precious information that arises from volumes.

The trading system should be programmed considering all the rules of money management and following the steps necessary to create a profitable system, starting from the basic concepts, programming it and then spending the major part of time optimizing all the parameters, in order to achieve the most suitable values and back-testing the entire strategy after each change, to check the profitability of the modifications.

The adoption of an automated trading system guarantees to use always the same strategy of investment, respecting precisely the point in which enter and exit the market, adding consistency to the investment and preserving discipline. In addition, the modern trading systems has increased a lot the speed to open and close position in the market, allowing to conclude a very elevate number of trades in a short time and it lets to invest in different market and financial instruments, at the same time.

In the last years, the large access to automated trading system by a considerable part of the population, thanks the highly evolved, cheaper and easier pc and trading software, has changed the way to invest money; today, everyone who desires can create a trading system and begin to access financial markets with a low amount of money, from home and also leaving the computer when the system is programmed to work automatically.

This new way of trading, adopted by a number of investors in continue expansion, permits to reduce risks, keeping emotions apart. How suggests behavioural finance, the modern branch of finance, investors often are not rational; in particular, when they have to take decisions under pressure, or, in a very little time. Often, irrationality brings to compute irrational actions, that

an investor never does in normal situations. Trading systems permit to avoid irrational behaviours, defining the investment strategy at the beginning and valuating its benefits.

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