Determination the price of a share listed on the stock exchange

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Keys word
Technical analysis, fundamental analysis, trading, return.

Abstract

Do investment in stock exchange or currencies for the short term as to protect and make grow the capital is based on the anticipation of the prices which are generally established using technical analysis and/or the graphic study of the prices and the indicators of calculation (particularly in the speculative investment on the short term). Nevertheless, the investment in a long term strategy leads to take decisions of purchase and sale of the financial shares while considering the objective or subjective data of macroeconomic and financial order (fundamental analysis).

In consequence, the management of a portfolio of shares listed on the stock exchange and follow its performance with tools (software) to help decision-making which integrate several methods allowed with the choice to the investor (trader or portfolio manager) according to his strategy, his experience, his psychological profile (risk tolerance) and the targeted market(s).

The principal question for trading (daily, weekly or monthly) with shares is how to know market trends from volatility (fast evolution of the prices) and the reversal of trends to seize the available opportunities.

So, when the trading in stock exchange is dominated by the technical analysis, this paper proposes a simple method which allows understanding the gaps and reversals situation of the prices.

Introduction

Most of the participants experienced with trading the shares listed at stock exchange have learnt with practice that a clear and synthetic vision of the price should allow making positive returns durably by taking into account that the number of good decisions remains consequent with regard to the whole trade. Consequently the estimation of the price at moment t + 1 constitutes the essential element in the decision-making in trading at the stock market. As a reminder, the stock market price represents the last price on which a buyer and a seller agreed to complete a transaction. The price of the share varies according to the kinds of the order given for the purchase or the sale which must be placed into two categories: the first one concerns the sale or purchase at any price and, the second concerns sales and purchases according to thresholds or fixed intervals. These orders given onto the stock-exchange platforms were ordered according to the technical information available in generally on the market and in particular about the company. This information gives an idea of the trend established with regard to a series of daily fluctuations (prices) translated into four daily data (open, low, high and close price). These fluctuations (prices) are accompanied by information relative to the volume of exchange of shares which allows to give a perspective of the value of the exchanged volume (that is the ratio between the number of shares in circulation and the number of share traded, otherwise, the exchanged capital.

In a general way and, in case the exchanged capital is above 1 % in the opening of the market, it is reasonable to consider that the daily price of the share would be volatile. It's grounds for noting that the volatility represents the variance of the share with regard to its average price.

This volatility is established by the formula of the variance $V(X) = \frac{\sum_{t=1}^{n}(X_t - \overline{X})^2}{N}$ with:

X_t: Price of the share X at time t;

Xt : Average price of the X share;

N: Number of periods.

Variance measures the dispersion of a series relative to its mean. In other terms, it is the average of gap from the squared average and is between 0 and 1.

Nevertheless, for professional traders, the volatility of a share price over a period (t) represents its amplitude represented by the following formula:

$$\text{Volatility (t)} = \frac{\text{(the highest price} - \text{the lowest price)}}{\text{(average price)}}.$$

With (t) expressed in months or days or hours or in intervals of : 15 minutes or 5 minutes or 1 minute.

For others, the volatility of the share is expressed in percentage and, it is estimated by the standard deviation, with a determined period and takes the naming of risk. The volatility or risk was estimated according to the following formula of standard deviation: $\partial(x) = \sqrt{V(x)}$.

In consequence, the understanding of the volatility varies from an investor to the other and one can classify them by levels going from 1 to 5 respectively to the rates lower than 20 %, from 20 to 40 %, from 40 to 60 %, from 60 to 80 % and of 80 to 100% (Botraider, bourse big data, 2007).

Of what precedes, the position of every investor in a stock exchange adheres to one of the two forms following;

The preference of volatility and we find on one hand, the speculators who intervene on very short-term horizons, going from a few minutes (to scalp) in a few days (for those who practice the swing trading). On the other hand, the investors who intervene in a market on the basis of a thorough financial analysis of the share on giving a potential of earnings on the short, average and long term. The aversion in the volatility and we find on one hand, the beginners in stock exchange who avoid the shares which presenting too much stress and, on the other hand, the institutional investors which stay away from the volatile shares because they adopted a strategy which limits the yields to a risk in the low threshold (the level or the very low rate of the volatility).

So, whatever is the investor and his attitude with regard to the volatility, the methods used in any decision to buy or to sell shares in a stock market obey following both tools: the technical analysis which concentrates more on the past movements of the price of the share rather than on the fundamental determiners of its future profitability (yield with regard to the price). The technical analysis admits that the data crossed on the prices and the volumes of transactions give a signal to the movements of the future prices. The other tool being fundamental analysis (stock picking) which handles the influence of the economic environment in general as well as the specific characteristics of the sector in which the company operates and on its current value based on its financial statements. Otherwise, the fundamental analysis is based on the use of financial and accounting data, and economic forecasts to determine the price of the share. The principal preoccupation of the fundamental analysis consists in determining the intrinsic value of an investment by trying to estimate the future profitability of the company.

In fact, (Fama 1970, p. 383) has given three forms of market efficiency (low, semi-strong and strong), which may not develop in a stock exchange when the technical analysis takes over on the fundamental analysis. Because the technical analysis leans on graphical representations and a series of indicators to identify the tendency of the price and the reversals while for the fundamental analysis, it's a question of identifying the shares that have a price which is lower than its fundamental value (underestimated) to resell them at a higher price or simply identify the shares which assure the profits.

And in case the market is dominated by the technical analysis, the decision to purchase or sell the shares concentrates on the basis of the history of the prices of the shares and not on a set of information. And it's the case for the foreign exchange currency market of the short-term, in which

fundamental analysis dominates (Neely & Weiler, 2011, p. 79). These lead professionals in this market to avoid trading during the timings of information announcements.

In consequent, the market where the technical analysis establishes as the rule, the investors of this market would prefer shares with high volatility because they offer many opportunities. In this context, the decision to invest is taken on the basis of a good graphic reading of the prices according to a representation (candlesticks, Bar-Charts, curve, etc.) and, according to the used units of time (1 minute, 5 minutes, 15 minutes, one half an hour, 1 hour, 4 hours and 1 day, 1 week or 1 month) and the horizon of investment. With this good reading of graphic is added the identification of the tendency of the value which is built on the one or following both techniques:

The chartist analysis or the Chartism, that is the study of the graphs of the prices of the share to which join visualized figures or visualized the constructed figures that they are tendencies (trends, channels…. etc.), or consolidation (triangles, bevels….), of reversal (double top, bottom, ….etc) or read the Japanese candlesticks such as the doji, the hammer and the hung, the inverted hammer and the falling star, the star of morning or evening, haramis, …). These figures allow to identify levels of the prices (levels of support and resistance, tracings of Fibonacci, gaps, … etc.) for anticipate the prices;

The use of the mathematical indicators (technical) such as the moving averages (simple, balanced, exponential) in 9, 20, 50, 200 days, and the indicators of power unbounded (momentum, macd…), and the indicators of power bounded (RSI, stochastic, ….). These indicators in the number which exceeds one hundred, they can be classified in three categories according to their degrees of importance:

- The dynamics of the prices: the relative strength, the momentum, … ;
- The divergence: the analysis of the volumes, on Balance Volume (OBV), ………. ;
- The analysis of the trend: the levels of support and resistance, the moving averages, the DMI, etc.

The preponderance of the graphical analysis in relation to the technical indicators or the technical indicators compared to the graphical analysis in the decision of each trade differs from one stock market to another and depends on the culture of the market. As an indication, the graphic analysis of Ichimoku Kinko Hyo is the technique commonly used in Japan and in Asian markets.

We retain that the technical analysis represents the study of the evolution of the market, mainly on the basis of graphs, with the aim of planning the future tendencies (MURPHY 1986, p. 32-120). Nevertheless, for the practitioners, the technical analysis is based on the principle formulated by Charles Dow who identifies three major tendencies for the price of the share which are the result of the information and the knowledge concerning the share available to the market.

First, market movements may be decomposed into primary, secondary and tertiary trends, the most important of which are Bull and Bear markets, both of which are characterized by fundamental economic activity as well as market price changes. Bull markets have three stages: "first...[is]...revival of confidence in the future of business...second is the response of stock prices to the known improvement in corporate earnings, and the third is the period when speculation is rampant and inflation apparent." For primary bear markets, "the first represents the abandonment of the hopes on which the stocks were purchased at inflated prices; the second reflects selling due to decreased business and earnings, and the third is caused by distress selling of sound securities, regardless of their value (Brown, Goetzmann & Kumar 1998, p. 5).

The tools of the current technical analysis

The technical analysis uses functions to exclude the echo (resonance) of the prices which show themselves in the form of small oscillations on the curve. So these values are extirpated out of the curve to reflect a more appropriate market trend (Sennhauser 2008, p. 9).

The Moving Averages

The moving average is the filter most used by the analysts for its simplicity. There are several sorts of moving averages and the simple moving average, the balanced moving average and the exponential moving average are the most used. The Arithmetical Moving Average (MMA) of the prices is calculated on the basis of an average of number of days (n). The moving balanced Average (MBP) affects a weighting more important for the most recent periods. The calculation principle of MBP consists in making the division between the sum of the multiplications of the price by a coefficient of every observation according through order chronological affected by weight and the sum of these coefficients. This calculation is represented by the following formula:

$$\mathbf{MMP} = \frac{nP_t + (n-1)P_{t-1} + \cdots\ldots + 2P_{t-1} + P_{t-1}}{n + (n+1) + \cdots\ldots + 2 + 1} \quad \text{or}$$

N: represent the number of days;
P: represent the price of the share and t: represent the day of the quote.

And as regards the exponential moving average (EMA) it's calculated by adding a price fraction of day (price of close) with the value of the moving average of the day before (EMA_{t-1}) that's calculate :

$$\mathbf{EMA} = \mathrm{EMA}_{t-1} + \frac{2}{Period+1} * (P_t - \mathrm{EMA}_{t-1}) \text{ , Wither:}$$

$\mathbf{EMA_{t-1}}$ It's the value (price) of the moving average of the day before, $\mathbf{P_t} =$ the closing price of the day and $\frac{2}{Period+1}$ is the exponential percentage is, which depends on the period of calculation the moving average.

The technique of use of these averages consists in visualizing the crossing between some kinds of moving average (in number of different days) which help to predict on probable change of price. Sometimes, the used crossing is between the price trend and one of these averages.

There are other moving averages such as, among others: Average True Range (ATR), End Point Moving Average, Moving Average Convergence Divergence (MACD), Triple Exponential Moving Average (TRIX) and Variable Index Dynamic Average (VIDYA).

Chartist figures (chart pattern)

A pattern is a discernible regularly in the world or in a manmade design. As such, the elements of a pattern repeat in a predictable manner. A geometric pattern is a kind of pattern formed of geometric shapes and typically repeated (Internet Pattern 2018). So a chart pattern is a pattern that is formed within a chart. In stock and commodity markets trading, chart pattern studies play a large role during technical analysis. When data is plotted there is usually a pattern which naturally occurs and repeats over a period of time. Chart patterns are used as either reversal or continuation signals.

So the examples of classical chart patterns as popularized (Edwards & Magee, 2007) and used widely by traders and investors include : head and shoulders, trend lines, cup and handle, double top and double bottom, triple top and triple bottom, broadening top, price channels, wedge pattern, triangle, flag and pennant patterns and elite patterns. There are other graphical configurations that give indications of price movement such as Elliot's wave.

The Oscillators

Oscillators or power indicators defined by (Béchu & Bertrand, 1998) as a derivate of the prices wherein data on the prices are used in formula (more or less complex) allowing obtaining a new series of data which oscillates around a precise level. The purpose of an oscillator is to determine what trend the share is in and to identify the most probable new trend and more specifically, it tries to detect the end of the trend.

For (Dublanc 1991), the technical indicators, by different manipulations of the data of the prices, will try to filter at best the useful information. This information has two natures: on one hand, the trend or the directional component which is filtered through the monitoring indicators of trend and on the second hand a cyclic component. The oscillators will try to retain only this cyclic component. These oscillators indicate the periods when the prices rose too far or fell too low when compared with a situation of equilibrium in their current cycle.

For indication, we can quote some indicators like: Momentum, Relative Strength Index, Stochastic oscillator, Williams %R, Know Sure Thing (KST), Bollinger Bands, ..etc.

Synthetic indicators

A synthetic indicator makes it easier to understand the movement of the trend. It's characterized by a sensitivity to price variation. They are of two categories, one measures volumes such as: volume, accumulation & distribution index, money flow index, On-balance volume, volume price trend, force index and negative volume index and the second measures the volatility such as: Donchian channel, Standard deviation, performance, …etc.

The indicial indicators

The indicial indicators give an indication about stock market movement. The goal of this indicator is to give the cumulative sum of the daily difference between the number of issues advancing and the number of issues declining in a particular stock market index (Edwards & Magee, 2007). We can mention as an indication: Advance decline line, Commodity Channel Index, Coppock curve, Keltner channel, Ulcer Index.

Other indicators: They represent the indicators that do not appear in the above ranking.

The kinematic method for the estimation

Every forecast realized on a share is accompanied by a reliability, to help the investor in its choices of purchase and sale of shares. But a bullish or bearish forecast doesn't constitute necessarily a signal of purchase or sale. So, because the potential of evolution of the share is limited or the reliability of the methods or tools used for this forecast are weak giving a low confidence.

So, we suggest studying the forecast of the trend of the prices through the kinematics and which consists in explaining the changes of the prices in their reports in time in the same way of the study of a movement in a given space and, in with don't worry about causes of the movement. And we consider that the variation of prices constitutes a rectilinear movement uniformly varied.

The position of a price

The trajectory establishes the successive positions of the price (moving) with regard at a chosen landmark. The movement is said rectilinear, if the trajectory is straight and, it is curvilinear in the other cases.

The landmark is reduced to an axis (Ox) of the plane of the curvilinear trajectory and at each instant (t) corresponds a position of the price (moving). It's characterized (t) as the date or unit of time that measures the time interval between prices and whose initial date is arbitrarily zero. So the price movement is a function of time.

Whether: P= f(t) [P: price, t : time with P=0 à t=0].

The graph of this function constitutes the diagram of the movement in time.

$$\vec{P}(t) = a_0 * \vec{u}_i = \text{constant} = a_0$$

The speed of the price

If the price is at the position M(p) at time t and at the position $M'(p + \Delta p)$ at the time $(t + \Delta t)$, increasing the vector of the position $\Delta(\overrightarrow{OM})$ for component $(\Delta p. \vec{1})$. The average increase from t to $(t + \Delta t)$ is $\frac{\Delta(\overrightarrow{OM})}{\Delta t} = \frac{\Delta P}{\Delta t}.\vec{1}$ is the speed vector of movement between t and $(t + \Delta t)$.

Thus $\mathbf{S}(t) = \sqrt{\left(\frac{dP}{dt}\right)^2}$, or again $\mathbf{S}(t) = \frac{dP}{dt}$ knowing that S(t)= a where (a) is a constant.

We can write otherwise the equation of speed: $\mathbf{S}(t) = \int a_0. dt = a_0 t + v_0$
($\mathbf{v_0}$ is a constant of integration).

The unit of speed describes units of the prices and the units of time. The unit of speed is calculated according to the local currency and/or may be expressed in penny / minute or in Dollars / day.

Thus, the hourly equation of the price P=f(t) is achieved by integrating speed S(t), that is obtained by the differential equation of price movement $\vec{P}(t) = a_0$

$$P(t) = \int S(t). dt = \int (a_0 t + S_0)dt = \frac{1}{2}a_0 t^2 + S_0 t + p_0$$

$\mathbf{S}$: The constant of the integral.
$\mathbf{S_0}$ and $\mathbf{p_0}$ are determined by the initial conditions at t=0.

By referring in the expressions of speed and price to ($\mathbf{S_0}$=0) et (p_a=0) when t=0, we obtain:

$$P(t) = \frac{1}{2}a_0 t^2$$

The acceleration of the price
From any position taken as origin, if we trace for any value of t a speed vector $\vec{S}_t$ which constitutes the hodograph of the price movement P, at times t and $(t+\Delta t)$, correspond to positions P et P' and that correspond to the vectors $\overrightarrow{OM}$ et $\overrightarrow{OM'}$ which represent the speeds S et $\mathbf{S'}$.

Where $\mathbf{\gamma}$ is the speed vector with respect to the position M et M'. We saw that: $S(t) = \frac{dP}{dt}$.

In the same way $\frac{dS}{dt} = \frac{d^2 P}{d^2 t}$ and which represents the second derivative with respect to time for the considered date t.

The unit of acceleration that describes the speed and the time unit squared is a function of the local currency and / or can be expressed in pence / minute^2 or $ /day^2.

So the price is expressed by the following formula: $\mathbf{P = \frac{1}{2}\gamma t^2 + v_0 t + p_0}$

With $S = \gamma t + s_0$ and $P = \frac{1}{2}\gamma t^2 + s_0 t + p_0$ and by replacing t between these two equations, we obtain a relationship between the values of the price and the speed independently of the time:
$S(t) = \int a_0. dt = a_0 t + S_0 = \gamma t + S_0$ = $\Rightarrow \frac{(S - s_0)}{\gamma} = t$

And $P = \frac{1}{2}\gamma t^2 + s_0 t + p_0$ $\Rightarrow P - p_0 = \frac{1}{2}\gamma t^2 + s_0 t = \frac{1}{2}\frac{(S - s_0)^2}{\gamma} + \frac{s_0}{\gamma}(S - s_0)$
$2a_0(P - p_0) = (S - s_0)^2 + 2s_0(S - s_0)$ $\Rightarrow$ $2\gamma(P - p_0) = S^2 - s_0^2$
$\mathbf{S^2 - s_0^2 = 2\,\gamma\,P}$
At: $\mathbf{t_0} = 0 :$ $s_0 = 0$ and $p_0 = 0$
The previous equations (Cessac & Tréherne 1972, p. 18) become:

$$P = \frac{1}{2}\gamma t^2 \quad \text{and} \quad S = \gamma \, t \quad \text{and} \quad S^2 = 2 \, \gamma \, P$$

We note that the constant vector $\vec{P}(t) = a_0$ isn't enough to say that the movement is straight uniformly varied. If the speed vector S_0 at t=0 isn't following the direction of the vector acceleration, the movement will be flat, in the plane containing S_0 and a_0.

It is thus necessary to add a condition: that the movement is rectilinear or to specify that at the moment t any vector acceleration and vector speed are collinear. The movement is uniformly accelerated if the speed is an increasing function of t. The movement is slowed down if the speed is a decreasing function.

Practical aspect

A choice on a financial title (share) on a branch of industry is established on the French company Peugeot, a car manufacturer. This choice is a random choice and having for origin two reasons which are on one hand, this is a mature branch of car industry and on the other hand, the data of the prices of the share on a unit of time (day) are available from January 3rd, 2000 until January, 2018. The automobile industrial sector knew a major crisis from the end of 2007 till 2009 (problem of economic environment) and, the share price of Peugeot company was at the lowest at the end of 2013 because, it announced a net loss equal to 5 billion Euros for the 2012 fiscal year.

Figure 1: The price of share for Peugeot Company from April, 1999 to February, 2018 (by year in Euro currency)
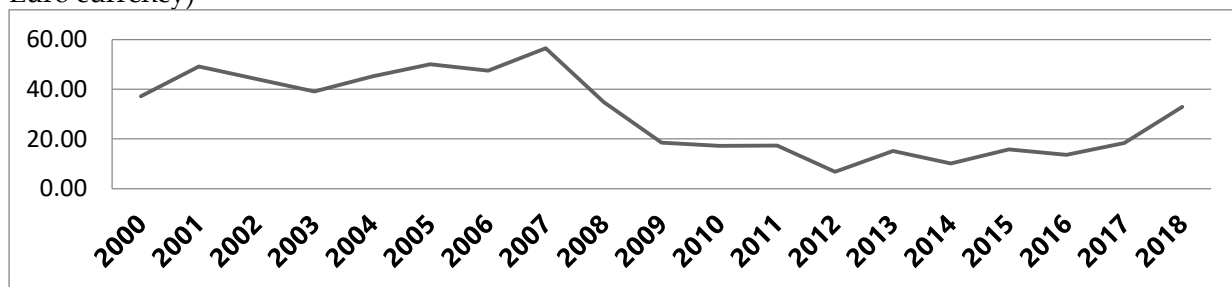
Source: Author

We will try from the equations what were mentioned above with the data collected from Stock Exchange of Paris (France) for any month because the time is equal one day.

Table 1: Share price for Peugeot Company during the month of January 2000
(at 1:00 AM close price- in Euro currency)

Date	Open	High	Low	Close	Volume	Date	Open	High	Low	Close	Volume
03	38,00	38,03	36,83	36,83	90292	-	-	-	-	-	-
04	37,48	37,48	35,52	36,13	236501	18	39,92	40,25	39,12	39,18	114292
05	35,10	35,83	34,67	35,33	238473	19	39,17	39,38	38,37	38,77	136958
06	35,33	36,45	35,17	36,33	177045	20	38,67	38,78	38,00	38,35	147226
07	36,83	37,17	35,70	36,67	179313	21	38,08	39,17	37,95	38,65	92687
10	37,33	39,00	36,83	38,22	236810	24	38,50	38,83	38,17	38,70	148134
11	38,22	38,67	37,87	38,00	223426	25	38,80	39,17	38,17	38,50	142159
12	37,75	38,87	37,75	38,50	168751	26	38,58	39,17	38,10	38,42	155261
13	38,42	40,00	38,20	39,25	173637	27	37,92	39,10	37,02	38,37	598100
14	39,35	40,75	39,35	40,33	167027	28	38,05	38,67	36,17	36,67	346444
17	40,75	40,83	39,23	39,92	98989	31	36,12	36,77	35,88	35,98	229575

Source: Bourse direct 2004, brokerage company. Available from:
www.boursedirect.fr/fr/. [05 February 2018]

Calculation methods for table 2 components are :

The speed is calculated according to the following formula $S(t) = \frac{dx}{dt}$

$S_4 = \frac{36,13-36,83}{4-3} = -0,70$, $S_5 = \frac{35,33-36,13}{5-4} = -0,80$ …etc.

The acceleration designated by the formula $\gamma(t) = \frac{d^2P}{d^2t}$. So the calculation about the acceleration is as follows :

$\gamma_5 = \frac{-0,80-(-0,70)}{5-4} = -0,10$, $\gamma_6 = \frac{1-(-0,80)}{6-5} = 1,80$, ……..etc.

The price was estimated by the following formula: $P = \frac{1}{2}\gamma t^2 + S_0 t + p_0$ with t=1 day $S_0 = 0$ et $p_0 = 36,83$ €

So, $P_5 = \frac{1}{2}\gamma t^2 + p_0 = \frac{1}{2}.1,80.(1)^2 + 36,83 = 36,78$ €. ……etc.

Estimated price difference (discrepancy) = Estimated price - market price (closing price):

Example for January 5 $\Rightarrow$ Difference at Estimated Price = 36,78 - 35,33 = 1,45 €

The expected correction of price is the accumulation of the differences for each day, for example: for January 7 =1,450 – 1,400 = 0,050, for 8 January= $|-0,170| - 0,050 = 0,120$ …etc.

 Price correction expected on day D = [abs (difference in estimated price on day D-1) - Correction expected on day D-1]

So applying those formulas, we obtain this table:

Table 2: Share price estimates for Peugeot Company in 2000.

Date	Closing Price	Speed	Acceleration	Estimate Price	Discrepancy Price	Expected correction
03-01	36,83	-	-	-	-	-
04-01	36,13	-0,70	-	-	-	-
05-01	35,33	-0,80	-0,10	36,78	1,450	-
06-01	36,33	1,00	1,80	37,73	1,400	-
07-01	36,67	0,34	-0,66	36,50	-0,170	0,050
08-01	38,22	1,55	1,21	37,44	-0785	0,120
09-01	38,00	-0,22	-1,77	35,95	-2,055	0,665
10-01	38,50	0,50	0,72	37,19	-1,310	1,390
11-01	39,25	0,75	0,25	36,96	-2,295	-0,080
12-01	40,33	1,08	0,33	37,00	-3,335	2,375
13-01	39,92	-0,41	-1,49	36,09	-3,835	0,960
14-01	39,18	-0,74	-0,33	36,67	-2,515	2,875
15-01	38,77	-0,41	0,33	37,00	-1,775	-0,360
16-01	38,35	-0,42	-0,01	36,83	-1,525	2,135
17-01	38,65	0,30	0,72	37,19	-1,460	-0,610
18-01	38,70	0,05	-0,25	36,71	-1,995	2,070
19-01	38,50	-0,20	-0,25	36,71	-1,795	-0,075
20-01	38,42	-0,08	0,12	36,89	-1,530	1,870
21-01	38,37	-0,05	0,03	36,85	-1,525	-0,340
22-01	36,67	-1,70	-1,65	36,01	-0,665	1,865
23-01	35,98	-0,69	1,01	37,34	1,355	-1,200
24-01	36,07	0,09	0,69	37,18	1,105	2,555

Conclusion

With the data from table 2, the result is the different curves summarized in the following figure:

Figure 2: Curves of prices with speed, acceleration & correction of Peugeot Company
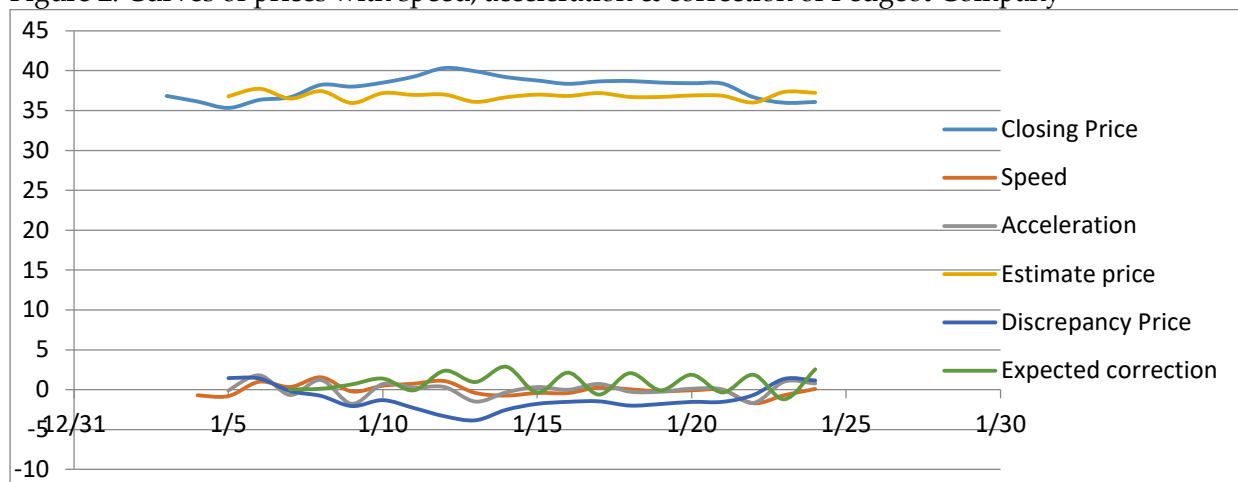
Curves of the figure n° 2 above, permit to deduce that from after the corrections brought by the traders (expected corrections), the estimated price and the price of the market (close price) cross by January 7th and between 22 and 23rd on January, 2000. Nevertheless, the different speeds give an idea to market trends in increase or the decrease, whereas the accelerations show the reversal of the trend. The deviations give an idea to the margins which can be realized, in low thresholds, it's necessary to expect low volumes (fewer liquid assets) and to assimilate Gap (less transaction on certain price levels).

Otherwise, on the mathematical plan, a function increase or decrease when the derivate is positive or negative (similarity with the speed of our application). The sign of the derivate gives an indication of the trend. As for the change of the trend, that proceeded to the calculation of the second derivate of the function (or derivate of derivate), when at zero, gives an indication to the change of the trend direction.

As a consequence, the estimation of a price of a share in the short term asks for a series of information summarized in the figure above with the hypothesis that no relevant information affects the company concerned by the estimation.

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