Practitioners' tools in analysing financial markets evolution

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Abstract. In a chaotic and confusing place as world of investing is, the practitioners, who operate on markets every day, have continuously searched to forecast properly the market movements. More minded to financial speculations, practitioners analyse financial markets looking for potential weaknesses of the Efficient Market Hypothesis, and most of the times their methods are criticised by academics. This article intends to present the traditional tools used by traders and brokers in analysing financial markets, emphasizing on critical opinions and scientific works published on this argument by now.

Keywords: Efficient Market Hypothesis, financial market analysis, fundamental analysis, technical analysis.

JEL classification: G14, G17, G19

1. Introduction

Generally, the methodologies used in analysing financial markets differ with the respect of the economic aim and foundation, and the focus of statistical fit. Thus, if the practitioners use methods that speculate the weakness of Efficient Market Hypothesis (EMH)[1] and Random Walk Theory[2], the academics use more accurate research instruments, considering the validity of EMH[3].

Those who are actively involved in financial markets activities have always pled that the market is predictable to some degree, so that the study of past prices can be used to forecast future price direction. Therefore they use in their market "examinations" the simple analysis of historic price evolutions and their correlations, or the evolution of companies' financial indicators, methodologies named technical analysis and fundamental analysis.

On the other hand, scientific researches regarding financial markets include, among other, largely econometric articles, where VAR and GARCH type models are the most used.

This article presents the latest critical opinion, scientific results and professional texts regarding the traditional tools used by practitioners in financial markets analyses. The goal of the present work is to

1 It is an investment theory that was first expressed at the beginning of the XXth Century (Bachelier (1900), Cowles (1933)) and more developed later, starting with the early 1960s (Samuelson (1965), Fama (1970)). The EMH stresses that stocks always trade at their fair value on stock exchanges, so the financial markets are "informationally efficient". The "informationally efficient" means that any new relevant information appears, the agents update their expectations appropriately and thus the prices include the new information. Although the EMH is considered a cornerstone of modern financial theory, it is seen as controversial by some authors and it is often disputed (see, for example, Lee *et al.* (2010)).

2 The Random Walk Hypothesis is a financial theory stating that stock prices perform according to a random walk. The stock price changes have the same distribution and are independent of each other, so the past movement or trend of a stock price or market cannot be used to predict its future movement. This theory was described as perfectly matching with the Efficient Market Hypothesis.

3 A comparative study regarding both academic and professional methods used in financial markets analysis is the aim of another research we made that will further be published.

enrich the poor academic literature regarding technical and fundamental analysis.

The paper is structured in five main parts. Thus, the 2nd Section contains a brief presentation of Efficient Market Hypothesis and its forms, followed by the 3rd Section where fundamental and technical analyses are largely presented, with their methods and the literature review, while the Section 4 is dedicated to the criticism regarding these analyses. The 5th Section concludes the paper.

2. The EMH and the financial markets professional analysts

As Bodie *et al.*(2003) assert "investors invest for anticipated future returns, but those returns rarely can be predicted precisely". Business cycle theorists believed tracing the evolution of several economic variables over time would clarify and predict the progress of the economy through boom and bust periods. The behaviour of stock market prices over time is the most suitable for this kind of analysis and one of the first to examine stock price changes was Kendall (1953). He found that he could not identify any predictable patterns in stock prices and prices seemed to evolve randomly. Thus, the data provided no way to predict price movements. In other words, Kendall's results imply that stock market follows no logical rules and at the beginning his affirmations disturbed some financial economists. However, on further reflection, economists seemed to accept and to share the idea that random price movements indicate, in fact, a well functioning or efficient market and not an irrational one.

Anyway, the competition among professional analysts and investors leads to market efficiency and it is not difficult to show how. Suppose, for example, there is a model able to predict stock prices. A prediction regarding the dramatic rise of stock prices within few days implies a great wave of immediate buy orders to cash in from all investors with access to the model's prediction. In this case, no one would be willing to sell, and the consequence of investors' behaviour would be an immediate jump in stock price. Thus, the forecast of *a future price increase* leads instead to *an immediate price increase*, because the stock price will immediately reflect the "good news" offered by the model's prognosis. So, a forecast about favourable *future* performance leads instead to favourable *current* performance[4].

More generally, there is a twofold conclusion from this example. Firstly, any publicly available information that might be used to predict stock performance should already be reflected in stock prices and this notion is referred to as the *Efficient Market Hypothesis (EMH)*[5]. The second conclusion is that as soon as there is any information indicating a stock is under-priced and offer a profit opportunity, investors will buy the stock and immediately bid up its price to a fair level[6]. So, it must be that prices increase or decrease only in response to new information. By definition, new information must be unpredictable. The conclusion is the stock prices that change in response to new and unpredictable information also must move unpredictably, following a *random walk (RW)* process.

The proof is obtained via the Law of Iterated Expectations[7].

Suppose that the price of stock considered above at time t is p_t and can be written as the rational expectation of some "fundamental value" V^*, conditional on information available at time t, I_t:

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4 In other words, the future price expectation, conditional on information available today, equals today's price (Bailey, 2005, pp. 57). This represents the martingale model, who can be written in its simplest form as: $E[p_{t+1} \mid I] = p_t$.

5 If the market prices fully reflect available information, markets are said to be *informationally efficient*. "Informational efficiency refers to the extent that asset prices reflect the information available to investors" (Bailey, 2005, pp.23).

6 At the fair level price, only ordinary rates of return can be expected.

7 The Law of Iterated Expectations says that "if one has limited information I_t, the best forecast one can make of a random variable X is the forecast of the forecast one would make of X if one had superior information J_t" (Campbell *et al.* ,1997, pp.23).

$$p_t = E\left[V^* \mid I_t\right] = E_t\left[V^*\right] \quad [1.1]$$

At the time $t+1$, the price p_t will be:

$$p_{t+1} = E[V^* \mid I_{t+1}] = E_{t+1}[V^*] \quad [1.2]$$

The expectation of the change in price over the next period can be written, considering equations [1.1] and [1.2], as:

$$E_t[p_{t+1} - p_t] = E_t[E_{t+1}[V^*] - E_t[V^*] \quad [1.3]$$

But the information set at time t is included in the information set available at time $t+1$ $\left(I_t \subset I_{t+1}\right)$, and the Law of Iterated Expectations says that:

$$E_t[E_{t+1}[V^*]] = E_t[V^*] \quad [1.4]$$

Replacing [1.4] in [1.3], results that

$$E_t[p_{t+1} - p_t] = E_t[V^*] - E_t[V^*] = 0 \quad [1.5]$$

So, realized changes in prices are unforecastable given information in the set I_t.

An important question regards the possibility that stock prices reflect all available information. The economic reality shows that there are lags between the new information availability and the market reaction. Moreover, it is possible to find that the degree of efficiency across various markets may differ. In the emerging markets, for example, information is harder to come by and thus this markets may be less efficient than developed markets, where information spread faster. Another example could be small stocks, which are less important for analysts and therefore could be less efficiently priced that large stocks.

In accordance with what the term "all available information" means, it is common to distinguish among three versions of EMH: *the weak*, *the semi-strong* and *the strong* forms of the hypothesis.

According to the *weak-form of EMH* stock prices already reflect all information publicly available regarding the market trading data, such as the history of past prices, trading volume or short interest. In this case, analysing the trend is useless because all investors have access to these information and their actions would result in an immediate price change.

The *semi-strong form efficiency* states that the information set contains all information known to all market participants and such information include, in addition to market trading data, fundamental data on the firm quality management, patents held, accounting practices and so forth. Any investor who has access to such information from publicly available sources will react and immediate price changes will be noticed.

The third form of EMH is the *strong* form. It states that stock prices reflect all information known to any market participant, even the information available only to company insiders. This version of the hypothesis is considered quite extreme.

Despite of all studies and demonstrations regarding the viability of EMH and their forms, it is not enthusiastically accepted by professional market analysts. Practitioners continue to analyse the historical price evolutions (technical and inter-market technical analyses) or the fundamentals of firms (fundamental analysis) in order to find trends that will enable them to earn abnormal profits.

There are not numerous scientific studies about fundamental and technical analyses, as these methods are typical for practitioners and not for academics. Even so, the published articles cover a vary range of arguments regarding these analysing methods, as further in the Section 3 are presented. Thus, there are articles who analyse if and how fundamental analysis and technical analysis can predict prices variations, other studies who investigate the influences of professional analysts on market price

changes, or even articles who consider these approaches not sufficient robust for a real analysis of financial markets.

3. Fundamental and technical analysis

As Werner F.M. De Bondt (1992) said at the beginning of 1990s, "security analysis is still more art than science" The methods used by practitioners to analyse securities and to make investment decisions are divided in two main categories: *fundamental analysis* (FA) and *technical analysis* (TA)[8]. The FA implies analysis of company's characteristics in order to estimate its value. The TA, named also *chartists analysis* has a complete different approach. It is not interested in the value of commodity or company, but only in the movement of the prices on the market. So, it is obviously that fundamental and technical analysis are not only two different approaches to the same question, but they are entirely different in nature. Fundamentals deal with corporate financial results, while technical indicators focus on stock price trends (Thomsett, 2006).

3.1 Fundamental analysis

There are vary definitions of fundamental analysis[9] and basically all of them emphasize that FA is a process of evaluating a firm for its investment worthiness by looking at its business, at the basic or fundamental financial level. Fundamental analysis is about investing all the "fundamental" aspects that affect the price of a security and, according to some authors, represents "the more influential method of security analysis" (De Bondt, 1992). It involves examining a firm's financial indicators and operations, and may also include the analysis of market behaviour (see Piotroski (2002), for example).

The theoretical basis for fundamental analysis is that the market's pricing mechanism reflects faulty and frequently irrational processes. Stock prices vary more rapidly and drastically than value[10]. Over the near term, the market seams to overreact to news and stock prices change, but on the long-run prices and values converge.

The fundamental analysts are represented by those who are convinced that prices will return toward their long-run equilibrium values. Hence, if the price is below (or above) its fundamental value, they will buy (or sell). Such a trading strategy tends to stabilized the market since prices are pushed toward their equilibrium values.

The main goal of fundamental analysis is to generate insights that are not already reflected by market prices. In other words, fundamental analysts pursue to enhance the ability to predict future security price movements and use such predictions to design equity portfolio.

Fundamental analysts usually start with a study of past earnings and an examination of company financial statements. They supplement this analysis with further detailed economic analysis, ordinarily including an evaluation of the quality of the firm's management, the firm's standing within its industry, and the prospects for the industry as a whole (Bodie *et al.*, 2003). There is not a single set of well defined tools that constitutes a fundamental analysis. Some of the valuation measures it uses, that

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8 Some authors (Chorafas, 2005, for example) assert that nowadays dividing the market analysis in only two categories is not generally accepted, because quantitative analysis has became a self-standing discipline. So, the opinions are divided. However, in this work the argument is developed according to the opinion that quantitative analysis is a subdivision of technical analysis, alongside charting analysis.

9 "Fundamental analysis is the research on determinants of stock value, such as earnings and dividends prospects, expectations for future interest rates, and risk of the firm"(Bodie *et al.,* 2003).

10 It must be mentioned here the distinction between market stock price and its intrinsic value. According to Cottle *et all.* (1988) intrinsic value is "the value which is justified by assets, earnings, dividends, definite prospects, and the factor of management".

are often used in other types of stock valuation techniques as well, are:

- *Earnings*. Fundamental analysis places much emphasis upon a company's earnings. Earnings are important to investors because they give an indication of the company's expected dividends and its potential growth and capital appreciation. However, that does not necessarily means that low or negative earnings always indicate a bad stock.
- *Earnings-per-share (EPS)*. It is an important indicator in order to make earnings comparisons more useful across companies. EPS is calculated by taking a company's net earnings and dividing by the number of outstanding shares of stock the company has.
- *Price-to-earnings (P/E) Ratio.* This indicator is necessary in order to know how the market values the stock and figures out how much the market is willing to pay for a company's earnings. A stock's *P/E* ratio can be calculated by taking its price per share and dividing by its *EPS*. There can be *"trailing P/E*" (calculated for the previous year), *"current P/E*" (for the current year), or *"forward P/E"* (for the coming year).
- *Projected-earnings-growth (PEG).* It is a ratio that takes into consideration a stock's projected earnings growth and is calculated by taking a stock's *P/E* ratio and dividing by its expected percentage earnings growth for the next year. *PEG* ratio is necessary due to the fact that the stock could have a high *P/E* ratio only because investors are convinced that it will have strong earnings growth in the future and so they bid up the stock's price now.
- *Dividend Yield*. The dividend yield measures what percentage return a company pays out its shareholders in the form of dividends. It is calculated by taking the amount of dividends paid per share over the course of a year and dividing by stock's price.
- *Dividend Payout Ratio*. This ratio shows what percentage of a company's earnings it is paying out to investors in the form of dividends. It is calculated by taking the company's annual dividends per share and dividing by its annual earnings-per-share (*EPS*).
- *Book Value*. The *book value* of a company represents the company's net worth, as measured by its total assets minus its total liabilities.
- *Price-to-book (P/B) Ratio*. The *P/B* ratio is determined by taking the company's per share stock price and dividing by the company's book value per share.
- *Price-to-sales (P/S) Ratio*. This indicator shows how much the market is valuing a company by comparing the company's price to its annual sales. It can be calculated by taking the stock's current price and dividing by the company's total sales per share for the past year.
- *Return-on-equity (ROE)*. *ROE* shows how much profit a company generates in comparison to its book value. The ratio is calculated by taking a company's after-tax income and dividing by its book value.

The authors of studies regarding the fundamental analysis strategy and the prediction of stock returns, particularly Piotroski (2000) and Elleuch (2009), have chosen twelve more complex fundamental indicators for their analyses: *inventory, accounts receivable, investments, gross margin, labour force, return-on-assets, cash flow, accruals, leverage, liquidity, assets turnover*; all these twelve fundamental signals are presented with their definitions in the Table 1.

Table 1 Definitions of fundamental signals

Signal	Measurement
Inventory *(INV)*	%Δ of sales - % Δ of inventory $\frac{\text{Sales}_t - \text{Sales}_{t-1}}{\text{Sales}_{t-1}} - \frac{\text{Inventory}_t - \text{Inventory}_{t-1}}{\text{Inventory}_{t-1}}$

Signal	Measurement
Accounts Receivable *(AR)*	%Δ of sales - %Δ of accounts receivable $\frac{\text{Sales}_t - \text{Sales}_{t-1}}{\text{Sales}_{t-1}} - \frac{\text{Accounts receivable}_t - \text{Accounts receivable}_{t-1}}{\text{Accounts receivable}_{t-1}}$ Earnings of operations is used as a proxy of gross margin.
Investments *(INVES)*	%Δ of firm investments - %Δ of sales $\frac{\text{Investments}_t - \text{Investments}_{t-1}}{\text{Investments}_{t-1}} - \frac{\text{Sales}_t - \text{Sales}_{t-1}}{\text{Sales}_{t-1}}$
Gross Margin *(GM)*	%Δ of gross margin - %Δ of sales $\frac{\text{Gross margin}_t - \text{Gross margin}_{t-1}}{\text{Gross margin}_{t-1}} - \frac{\text{Sales}_t - \text{Sales}_{t-1}}{\text{Sales}_{t-1}}$
Labour Force *(LF)*	%Δ of sales per employee $\left(\frac{\text{Sales}_t}{\text{Employees number}_t} - \frac{\text{Sales}_{t-1}}{\text{Employees number}_{t-1}}\right) \div \frac{\text{Sales}_{t-1}}{\text{Employees number}_{t-1}}$
Return on assets *(ROA)*	Net income before extraordinary items$_t$ / Total assets$_{t-1}$
Variation in Return on assets *(ΔROA)*	$ROA_t - ROA_{t-1}$
Cash flow *(CF)*	Cash flow$_t$ /Total assets$_{t-1}$ Cash flow = Earnings before extraordinary items - Accruals
Accruals *(ACC)*	Accruals$_t$/ Total assets$_{t-1}$ Accruals = (ΔCA – ΔCash) – ΔCL – Dep Where: ΔCA: change in current assets; ΔCash: change in cash/cash equivalents ΔCL: change in current liabilities; Dep: depreciation and amortization expense
Leverage *(ΔLEV)*	$\frac{\text{Long term debt}_t}{(\text{Total assets}_t + \text{Total assets}_{t-1})/2} - \frac{\text{Long term debt}_t}{(\text{Total assets}_{t-1} + \text{Total assets}_{t-2})/2}$
Liquidity *(ΔLIQUID)*	$\frac{\text{Current assets}_t}{\text{Current liabilities}_t} - \frac{\text{Current assets}_{t-1}}{\text{Current liabilities}_{t-1}}$
Assets Turnover *(ΔTURN)*	$\frac{\text{Sales}_t}{\text{Total assets}_{t-1}} - \frac{\text{Sales}_t}{\text{Total assets}_{t-2}}$

Source: Elleuch (2009), pp.101.

The benefits may be obtained using fundamental analysis only if the information are not yet recognized by the rest of the market. The efficient market hypothesis predicts that most fundamental analysis will add little value. If analysts rely on publicly available earnings and industry information, one analyst's evaluation of the firm's prospects is not likely to be significantly more accurate than another's.

3.2 Technical analysis

Technical analysis operates on the theory that market prices at any given point in time reflect all known factors affecting supply and demand, as well as a firm's relative financial strength. Thus, TA focuses on analysing market prices themselves, rather than directly evaluating of fundamental strength

or factors of supply and demand. Strategies based on TA generally utilize a series of calculations designed to detect when a price change is likely to occur so that an investor can manage market positions in the short-term, such as the case in highly leveraged derivative markets. In contrast, FA takes on a more long-term perspective in determining which firms are most likely to perform well in the future, based on their fundamental business strengths.

A briefly definition of technical analysis says that it represents "a research on recurrent and predictable stock price patterns and on proxies for buy or sell pressure in the market" (Bodie *et all.,*2003). Technical analysis assumes a slow response of stock prices to fundamental supply and demand factors, which is diametrically opposed to the notion of an efficient market. A very good synthesis of technical analysis philosophy is offered by Edwards and Magee (1992):

- the market value of an asset is determined only by the interaction between supply and demand;
- supply and demand are governed in any moment by numerous factors, either rational or irrational;
- prices use to move along trends that persist for a certain time period;
- trend changes that represent an important change in the balance between supply and demand, sooner or later can be identified in the actions of the market.

The aim of the technical analysis is to identify the increasing and decreasing trends of the market, and, most of all, to identify as early as possible the signals of trend changes, considered sell- or buy-action signals. Although technicians recognize the value of information that has to do with the future economic prospects of the firm, they believe such information is not necessary for a successful trading strategy. The basic principle of their analysis is that prices move in trends and thus they buy when prices increase and sell when prices decrease. Therefore, the information set necessary to develop the analysis contains only past prices and transaction volumes.

Technical analysis uses mostly *chart-based* techniques in order to evaluate the future potential trend of financial markets of individual securities. This is the reason why sometimes technical analysts are called *chartists*. *Chart-based* technique means the study of price time series trend and of indicators obtained using past prices and volumes. So, the methodology of technical analysis is very simple and rather intuitive. An example of a technical approach is the *relative strength* approach. The chartists compare the stock performance over a recent period to performance of the market or other stocks in the same industry. For example, a simple version of relative strength is the ratio between the stock price and a market indicator such as an important stock index. If the ratio increases over time, the stock is said to exhibit relative strength, because its performance is better than that of the broad market. Such strength presumably may continue for a long enough period to offer profit opportunities. The importance of *price trends* in technical analysis is crucial. The entire system is based on the idea that the most recent trends reveal and anticipate what is going to happen next.

Chartists use various trading rules to exploit true or imagined short-term patterns in prices. Pring (1991), for example, says that technical analysis include three broad areas: *market feeling indicators*, *flow-of-funds indicators* and *market indicators*. According to DeBondt (1992), the technical trading rules are: *market timing*, *filter rules*, *measures of "relative strength"*, *line and bar charts*, *200-day moving average in prices*, *the study of trading volume*, *aggregate demand/supply analysis*. More recently, presenting the comparisons between fundamental and technical analysis, Thomsett (2006) make a brief description of the most used concepts of technical analysis as following:

- ***Charts***. Charts represent the basic tools of technical analysis and are used to study price movements in the belief that specific patterns signal how future prices will change. Types of charts:
  - *Bar chart*: is a form a price charting in which a series of daily prices is shown side by side over time. The vertical bar shows the range of prices during the day from high to low. A small horizontal extension to the right shows the closing price for the day and some bar charts also include a small horizontal extension to the left for the day's opening price;

- *Close-only chart*: it is a tracking chart showing closing price only, but not the range of high and low price ranges.
- *Point-and-figure chart*: a type of chart used by technicians to track price but not time. Rising price and trends are represented by a series of Xs and the stronger the movement, the more Xs appear. Downward prices and trends are shown as a series of vertical Os.
- *Candlestick chart*: is a form of chart that efficiently summarizes a day's trading range, high and low price, and direction of movement.

- ***Trading range***. It is the distance between a stock established high and low prices over a period of time, representing the current levels of price supply and demand for the stock.
- ***Support and resistance***
  - *Support*: the lowest likely price for a stock within its established trading range.
  - *Resistance*: the highest likely price for a stock within its established trading range.
- ***Breakout.*** It represents a price movement above resistance or below support levels, which signals a change in trading range and volatility for a stock.
- ***Trading patterns***. Technical analysts look for specific patterns to reveal and anticipate future movements, often as quickly as a matter of days or even hours. These patterns have been given names:
  - *Gaps*: spaces between one day's close and another day's opening price.
  - *Spikes*: exceptionally big changes in price, upward or downward, when compared to established trading levels, and characterized by a return to previous levels after the spike.
  - *Triangles*: trading patterns in which the range of high-to-low prices broadens or narrows within a short period of time.
  - *Flags*: short-term trading patterns in a specific direction in which the gap between high and low remains constant.
  - *Pennants*: short-term trading patterns in a specific direction in which the gap between high and low converges over time.
  - *V Formations*: a price pattern typified by a sharp increase or decrease in price to a new high or low level, followed immediately by a sharp reversal and price movement in the opposite direction.
  - *Head and shoulders*: a price trend pattern involving three stages. In an upward head and shoulders pattern, stages one and three show prices reaching a resistance level before retreating, and the middle stage tracking the same movements but with a higher resistance level. In a downward head and shoulders pattern, the same stages exist, but they involve support levels rather than resistance.

So, technicians believe that history tends to repeat itself. This is, evidently, against the efficient market hypothesis that stresses any past trading information is already reflected in the stock price and therefore any analysis made in order to discover undervalued securities is useless. Hence, there are authors that consider profitable some methods based on technical analysis[11], even if other numerous studies show there are little statistical evidence suggesting that technicians can beat the market.

The often disputed arguments regarding the methods used by technical analysis have produced an opening of TA towards more rigorously techniques. Incorporating elements of statistical analysis into a traditional technical trading analysis can greatly improves the performance of professional trading forecasts. Murray A. Ruggiero (1997), in the Chapter "A trader's guide to statistical analysis" of his book "Cybernetic trading strategies", underlines there are some important statistical concepts that

11 Ruggiero (1997), for example, underlines that methods as *gap analysis*, *breakout systems*, *market modes* and *momentum preceding price* concept are profitable.

traders should understand[12].

Some other authors (Gallo and Pacini, 2002) analyse technical techniques from the statistical point of view and stress the possible link between technical analysis methods and more robust methodologies, as statistic and econometrics methods for time series. They also emphasize technical methods have no probabilistic or inferential considerations and their results have no explicit confidence level. Hence, some indicators could be interpreted more rigorously in a statistical-econometric environment. Gallo and Pacini (2002) present two categories of so called *indicators of technical analysis*:

- *trend indicators*: try to identify a particular trend and to signal the presence of a bullish or bearish market. The main trend indicators are:
  - moving average (*MA*);
  - exponential moving average (*XMA*);
  - Bollinger bands (*BB*).
- *moment indicators*: measure the power of an acting trend, and so to get an anticipated information regarding the trend exhaustion and the possible trend changes. Among moment indicators are included:
  - rate of change (*ROC*);
  - moving average convergence / divergence indicator (*MACD*);
  - relative strength index (*RSI*);
  - volume oscillator indicator (*VOI*);
  - on balance volume (*OBV*).

The definitions and calculation formulas for all the above indicators, according to Gallo and Pacini (2002), are put together in the Table 2.

Table 2 Technical analysis indicators

Indicator	Formula	Notes
Moving Average (MA)	$\mathrm{MA}(\mathrm{k})_t = \frac{1}{\mathrm{k}}\sum_{i=0}^{k-1} P_{t-i}$ for $\mathrm{k} = 4 \Rightarrow$ fast MA for $\mathrm{k} = 9 \Rightarrow$ slow MA	a) if $MA(4)_t > MA(9)$ $\Rightarrow$ bullish market b_1) if $P_t > MA(4)_t > MA(9)_t$ b_2) and $MA(4)_t > MA(4)_{t-1}$ b_3) and $MA(9)_t > MA(9)_{t-1}$ $\Rightarrow$ very bullish market c) if $MA(4)_t < MA(9)_t$ $\Rightarrow$ bearish market d_1) if $P_t < MA(4)_t < MA(9)_t$ d_2) and $MA(4)_t < MA(4)_{t-1}$ d_3) and $MA(9)_t < MA(9)_{t-1}$ $\Rightarrow$ very bearish market
Exponential Moving Average (XMA)	$XMA_t = (1-\alpha)XMA_{t-1} + \alpha P_t$ with $0 \leq \alpha \leq$, and $XMA_0 = P_0$ In technical analysis α is determined as $\alpha = \frac{2}{k+2}$	a) for $\alpha \to 0 \Rightarrow XMA_t = XMA_{t-1} = \ldots = P_0$ (XMA_t is represented by a parallel to the abscisa in P_0) b) for $\alpha \to 1 \Rightarrow XMA_t = P_t$, for $\forall$ t (XMA_t coincide with the original P_t series, the price series at current time)

12 According to Ruggiero (1997), pp.95, these concepts are as follows: mean, median and mode; standard deviation; types of distributions and their properties; how mean and standard deviation interact; hypothesis testing; linear correlation.

Indicator	Formula	Notes
Bollinger bands (BB)	lower BB: $BBL = MA(k)_t - mMTSD(k)_t$	a) if $\frac{P_t - BBL_t}{BBU_t - BBL_t} < 0.3 \Rightarrow$ bullish market
	upper BB: $BBU = MA(k)_t + mMTSD(k)_t$	b) if $\frac{P_t - BBL_t}{BBU_t - BBL_t} > 0.7 \Rightarrow$ bearish market
	middle BB: $BBM=MA(k)_t$	
	BandWidth: $BBU_t - BBL_t$	
	(*MSTD* represents *Moving Standard Deviation*, a statistical measurement of market volatility in technical analysis; *m* is a multiple of *MSTD* and its typical value is 2.)	
Rate of change (ROC)	$ROC_t = \frac{P_t - P_{t-k}}{P_{t-k}} \approx \ln(P_t) - \ln(P_{t-k})$	$ROC_{t+1}=ROC_t+\varepsilon_{t+1} - \varepsilon_{t+k-1}$
	$ROC_t = \sum_{i=0}^{k-1} \varepsilon_{t-i}$	So
		$ROC_{t+}1 > ROCt$ if and only if $\varepsilon_{t+1} > \varepsilon_{t+k-1}$
	where ε_{t-i} represents daily yield between *t-i* and *t-(i+1)*	
Moving average convergence/ divergence indicator (MACDI)	MACD = XMA(12day) - XMA(26day)	*MACD* buy or sell signals are signal line crossovers The signal line is 9-day *XMA* of *MACD*
Relative strength Index (RSI)	$RSI_t = 100 \frac{\sum_{r=0}^{k-1} \Delta^+ P_{t-r}}{\sum_{r=0}^{k-1} \Delta P_{t-r}}$	There are inferior and superior attention thresholds: a) for *RSI* = 20 - oversold b) for *RSI* = 80 – overbought Other limits could also be 30 - 70
	The values of RSI_t are $0 \leq RSI_t \geq 100$; $RSI_t < 0$ if $\Delta P_{t-r} < 0$ during all *k* periods	
Volume oscillator indicator (VOI)	$VOI_t = VMA(4)_t - VMA(9)_t$	if $VOI_t > 0$ $(VMA(4)_t > VMA(9)_t) \Rightarrow$ volumes sustain current trend
	where *VMA* = volume simple moving average	if $VOI_t < 0$ $(VMA(4)_t < VMA(9)_t) \Rightarrow$ volumes signal exhaustion of current trend and possible inversion
On balance volume (OBV)	$OBV_t = \sum_{r=0}^{t} \frac{P_r - P_{r-1}}{\lvert P_r - P_{r-1} \rvert} V_t =$	OVB_t series oscillate around zero if
	$= OVB_{t-1} + V_t \mathbb{1}(\Delta P_t^+) - V_t \mathbb{1}(\Delta P_t^-)$	$V_t \mathbb{1}(\Delta P_t^+) = V_t \mathbb{1}(\Delta P_t^-)$
	where	More negative OVB_t is, more the current decrease pressure is confirmed; in order to confirm this trend, the other indicators will be analysed.
	$\mathbb{1}(\Delta P_t^+)$ is 1 if ΔP_t^+ is true ($\Delta P_t > 0$) and 0 if ΔP_t^- is true ($\Delta P_t < 0$) and vice-versa for $\mathbb{1}(\Delta P_t^-)$	

Source: Gallo and Pacini (2002), pp.140-152.

Although the two analyses (fundamental and technical) are seen by many analysts as polar opposites, there are enough market participants who try to get profits by combining the two. Thus, some fundamental analysts use technical analysis techniques to figure out the best time to enter into an undervalued security. Oftentimes, this situation occurs when the security is severely oversold. By timing entry into a security, the gains on the investment can be greatly improved. Alternatively, some technical traders might look at fundamentals to add strength to a technical signal. For example, if a sell signal is given through technical patterns and indicators, a technical trader might look to reaffirm his decision by looking at some key fundamental data.

Vary papers underline that speculators rely on both technical and fundamental analyses to predict the directions of future market movements. Thus, the survey conducted by Lui and Mole (1998) in February 1995 on Hong-Kong foreign exchange dealers reports that more than 85% of respondents rely on both fundamental and technical analyses for predicting future rate movements at different time horizons. The authors emphasize that at shorter horizons dealers prefer technical analysis, but as the length of horizon considered is extended they prefer the fundamental analysis. Another conclusion of

this study is that technical analysis is considered slightly more useful in forecasting trends than fundamental analysis, but significantly more useful in predicting turning points. Some other recent studies, that analyse the equity markets in the U.S., assert that market participants place more emphasis on technical analysis and less on fundamental the shorter the time horizon is (Marshall *et al.,* 2008).

As literature confirms, fundamental analysis takes a relatively long-term approach to analyse the market compared to technical analysis. The two analyses are different not only from the time interval point of view, but the goal of a purchase (or sale) of a stock is usually different for each approach. Mainly, technical analysis is used for a trade (for speculations), whereas fundamental analysis is used to make an investment. Anyway, mixing some of the components of technical and fundamental analysis is not well received by the most devoted groups in each school, fundamental or technical, and they are the first who start to criticize the others' methods.

4. Criticisms of fundamental and technical analysis

Much of the criticism of fundamental and technical analyses has its roots in academic theory, specifically the efficient market hypothesis (EMH). Nevertheless, even the members devoted to each school of thought (fundamentalists or technicians) tend to criticize the other group. Fundamental analysts proclaim that financial results are the only dependable means for establishing the value of a company. The price trends, in the fundamental view, are short term, chaotic, and unreliable, caused by many conflicting and inaccurate momentary factors. The immediate supply and demand within the market is illogical, price movement overreacts to news and gossip, and much of the daily price movement is either random or artificial. On the other hand, technicians point out that by the time fundamental indicators offer accurate and reliable information, it is woefully out of date. The historical financial information published by a company has nothing to do with today's pricing trends or with the direction of price movements, the technicians believes. They underline that it is the timing decisions that determines whether you earn a profit or suffer a loss in the market.

But the biggest criticism of both methods comes from the academics, pleaders of the efficient market hypothesis and its forms. The believers of the efficient market hypothesis are usually in disagreement with both fundamental and technical analysts. The efficient market hypothesis contends that it is essentially impossible to produce market-beating returns in the long run, through either fundamental or technical analysis. The rationale for this argument is that, since the market efficiently prices all stocks on an ongoing basis, any opportunities for excess returns derived from fundamental (or technical) analysis would be almost immediately whittled away by the market’s many participants, making it impossible for anyone to meaningfully outperform the market over the long term. The weak form efficiency considers that all past price information is already included in the current price. According to this form of efficiency, technical analysis can not predict future movements because all past information has already been accounted for and, therefore, analysing the stock's past price movements will provide no insight into its future movements. In the second form of efficiency, the semi-strong, fundamental analysis is also claimed to be of little use in finding investment opportunities. The third version of EMH is strong form efficiency, which states that all information in the market is accounted for in a stock's price and neither technical nor fundamental analysis can provide investors with an edge. The vast majority of academics believes in at least the weak version of EMH, therefore, from their point of view, if technical analysis works, market efficiency will be called into question.

The most criticized of the two analyses has been the technical one. Maybe the most severe study regarding this argument is that of Neftci (1991) who, not only named the technical methods “naive trading rules”, but also emphasizes that “technical analysis is a broad class of prediction rules with unknown statistical properties, developed by practitioners without reference to any formalism”. His article investigates statistical properties of technical analysis in order to determine if there is any objective basis to the popularity of its methods. Later, Marshall *et al.* (2008) find, using other methodologies, that none of the 7846 popular technical trading rules they test are profitable after data snooping bias is taking into account. They conclude that there is no evidence that the market is inefficient over the analysed time horizon (January 1, 2002 - December 31, 2003).

During the past years, vary articles regarding the robustness of technical and fundamental methods were published, some of them disputing even the validity of efficient market hypothesis in the favour of arbitrage opportunities. In the 1998 Lim *et al.* (1998), for example, obtain as research result that market inefficiency persist for at least one month and these possible profitable arbitrage opportunities appear to occur throughout the time period tested (November 1988 - December 1993). However, the frequency of potential arbitrage opportunities appears to decline in the more recent time period examined. So, the findings suggest also that the increased levels of activity in the international stock and international bond markets may be contributing to higher levels of market efficiency over time. Different studies of mean reversion in stock prices confirm that two- to five-year returns are surprisingly predictable (De Bondt and Thaler (1989), for example). Thus, the data appear in conflict with random walk theory and with the notion of efficient markets. More recently, Lee *et al.* (2010), analysing if the efficient market hypothesis holds in stock markets under different economic development levels, conclude that real stock price indices are stationary processes that are inconsistent with the EMH. This shows the presence of profitable arbitrage opportunities among stock markets.

There are also numerous studies that proof abnormal returns using fundamental and technical analysis are possible to be obtained. Ou and Penman (1989) were the pioneers in this research area, and their study conclude that fundamental analysis identifies equity values not currently reflected in stock prices, and thus systematically predicts abnormal returns. Other scholars have developed models to analyse a firm's financial statements over time in order to determine a relative financial strength indicator that is predictive of firm's stock price returns (see Edirisinghe and Zhang, 2007). Elleuch (2909) examines whether a simple fundamental analysis strategy based on historical accounting information can predict stock returns. The results show that over-performance of the winner portfolio seems to be attributable to the ability of the fundamental signals to predict future earnings.

Despite of their different tools used in analysis of financial markets, the chartist and fundamentalist approaches explicitly model the market behaviour. Vary studies assert the impact of traders' behaviour on market dynamics and proof that, while the market impact of fundamental traders is constant over time, the market impact of technical traders is time varying and depends on market circumstances (Westerhoff and Reitz, 2005)[13]. To be mentioned here, among other studies, the contributions such as those of Kirman (1991), Brock and Hommes (1997), Brock and Hommes (1998), Lux and Marchesi (2000), Westerhoff (2003) and more recently Tramontana *et al.* (2010).

As can be noticed, many studies document significant abnormal returns. Their approaches focus on the market's inability to fully process and immediately reflect the implications of particular financial signals into price.

5. Conclusions

The financial markets' actors are convinced that the market is predictable and they can use past prices evolution in order to forecast future price directions. Their idea is contrary to the Efficient Market Hypothesis, according to which stocks always trade at their fair value, so the prices include all the available information that could give a profit opportunity.

There are three forms of EMH, each of them demonstrating that analysing the price trends is useless because all investors have access to information, and their actions would result in an immediate price change.

The two methods used by practitioners in financial markets analysis, namely *fundamental analysis* and *technical analysis*, are very different in concepts and approaches.

Thus, the basis for fundamental analysis is that the market stock price vary more rapidly and

13 Westerhoff and Reitz (2005), analysing the corn market in the U.S.A., emphasize the market impact of chartists increases when prices run away from their fundamental values. Since the market impact of fundamentalists remains constant, the market may temporarily stop tracking its fundamental value. As long as technical traders increasingly enter the market as the price deviates from its long-run equilibrium value, lasting and pronounced bull and bear markets may emerge.

drastically that stock intrinsic value, but on the long-run prices and values converge. Fundamental analysts develop their forecasts starting from a study of past earnings and an examination of company's financial statements.

On the other side, technical analysis operates on the theory that market prices at any given point in time reflect all known factors affecting supply and demand, as well as a firm's relative financial strength. Therefore, technical analysis focuses on analysing market prices themselves, rather than directly evaluating of fundamental strength or factors of supply and demand.

The main difference between the two methods is that TA utilises a series of calculations in order to detect when a price change is likely to happen so that an investor can manage market positions in the short-term, while FA, in contrast, takes on a more long-term perspective in determining which firms are most likely to perform well in the future, based on their fundamental business strength.

There is not a vast scientific literature regarding these methods of financial markets analysis, maybe because of the contrary view of the academics regarding the properly approaches needed in this analysis.

Anyway, in practice the two methods are used together most of the times, even if mixing some of the components of TA and FA is not well received by the most devoted groups in each school.

Both methods are criticised by the academics, especially by the pleaders of the EMH and its forms, but the most criticised have been the technical analysis. Even so, during the past years vary articles were published regarding both the inefficiency of these methods and their robustness, some of studies disputing even the validity of EMH in the favour of arbitrage opportunities.

The practice shows us that the tools used by practitioners in financial markets analysis could offer investment returns, but during financial turmoil their methods can not be considered as standard approaches that could guarantee significant abnormal returns.

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