Forecasting methods and stock market analysis

VIRGINICA RUSU and CRISTIAN RUSU

ABSTRACT. The paper briefly analysis the methods used in forecasting of the stock market quotations, from the classic methods, used by the fundamentalists and chartist annalists, to the newest methods. The practical situations, where the analyzed methods are suitable, are also indicated.

1. INTRODUCTION

The development of the stock market is a necessity both for the assurance of a continuous economic growth and for the efficient allocation of resources in economy. The most important sector of the capital market in Romania, the **stock exchange market**, is defined and regulated by the Law No. 52 (7th of July 1994).

A major role in the stock market development is played by the legislation, mainly by those particular laws that concern the transparency, the protection and the equal treatment of the investors. It maintains the confidence of the investors in the stock market and persuades them to invest in it.

As a representative institution of the capital market, the stock market performs various functions: (1) *the optimal frame for the market transactions*, (2) *the transactions' transparency and the investors' protection*, (3) *the generation of the correct price*, (4) *the harmonization of the prices for the entire economy*, (4) *the division and the cover of the risk*, among others.

The **stock quotations** represent the prices for deals at the stock exchange market. They reflect the relationship between the demand and the supply on that market. The main factors that influence the stock quotations are: (1) *the economic status of the remittent*, (2) *the investors' expectations concerning the profitableness and the dividends*, (3) *the evolution of the national and international stock market, and the specific particularities of the stock market activity that affect the demand and the supply*, (4) *political, military, cultural factors*, and others.

The price established on the market becomes an instrument for the economic analysis and forecasting. It is the most realistic instrument of prognosis, used when deciding the economic policy, and it is an action signal for

the economic agents, governments and local authorities. That is why the forecasting of the stock quotations is extremely important.

2. Forecasting and stock market analysis methods

Depending on how the shares are evaluated, the stock market analysts can be classified as: (1) ***fundamentalists***, they consider only the fundamental factors of the market, and (2) ***chartists***, they use graphic analysis techniques.

The fundamental analysis is based on the study of the economy, field and society state, with a view to determining the value of the share of a specific company. Fundamental analysis monitors the profits of the company and the dividends that the company offers, takes into account the expectations about interest rates, and evaluates the risk associated with the company. It uses statistical, mathematical and financial algorithms, applied to the official periodic financial statements of the company, in order to evaluate, as correctly as possible the shares' price.

The technical analysis is based exclusively on the study of the internal data of the stock market, considering that all the economic, financial, political and psychological factors are incorporated into a single element: the share quotation. The technical analysts study the short-term changes of the shares' price, starting with a study of the history of the quotations, within an interval of at least 6 months, and assume that the past behavior will extend into the future. The technical analysis offers information about the possible future evolution of the stock market.

In the last few decades a new theory on the share prices evolution has been developed, namely **the efficient market theory**. The main attributes of this new theory are:

- the market prices of the stocks reflect instantaneously and completely all the relevant information available at a given time,
- the share prices must always reflect their real (fundamental) value,
- the information has to be inexpensive or even free, and should be available to all the participants on the market,
- the share prices follow a random walk evolution.

The following table shows a comparison between the three above-mentioned theories, based on their aims, their suppositions, their methods, their target users, and the recommendations that can be made to the investors.

The dynamics of the processes in the economy cannot be ignored. The **time series model** takes into consideration the past behavior of a given variable and uses this information to predict its future behavior. It considers

	Technical analysis	**Fundamental Analysis**	**Efficient market theory**
1. Objectives	The short-term prediction of the share price, based on their historical evolution.	The determination of the "intrinsic value" of the shares, based on economical and non-economical factors.	The explanation of the formation of the share price, based on a general behavior model, named the "efficient market".
2. Suppositions	The prices' series and the transaction volume describe some trajectories and trends that will repeat in the future, and the shares' price is determined by demand and supply.	The market value of a share has to oscillate around its intrinsic value. Otherwise the share is over or under estimated.	The markets do not have memory; any information regarding the share is instantly adjusted in price; that is why the past is of no help in predicting the future.
3. What it recommends to the users?	Tells the users which and how many shares they have to buy or sell in order to gain profits.	Tells them what they have to buy in order to obtain benefits.	The *weak hypothesis* tells them that the historical prices of shares are random and do not contain useful information that should lead to over-the-average earnings. The *intermediate hypothesis* indicates the time delay of the price adjustment to new information. The *strong hypothesis* shows that nobody will earn more, regardless of the strategy that is used, because all the information is inside the price.
4. Which are the target users?	Mainly speculators and short-term investors.	Mainly people who want to save and long-term investors, not interested in the short-term fluctuations.	Both speculators and long-term investors.
5. Methods that are used	Study of graphs, time series and a certain dose of common sense.	Economical-financial studies, macro-economical analysis, multi-variate statistical analysis, behavior theory (psychology, sociology, politics).	Statistical methods (regression and correlation analysis), the test of the signs, the rule of the filters, econometric analysis.

that there is no information on the causality relationship, which affects the variable that has to be forecast.

Generally speaking, a time series model will be preferred when: (1) we have little information on the factors that affect the behavior of the variable, (2) we have a great amount of data, or (3) the main aim is short-term prediction.

The time series analysis starts by building a data model whose properties are similar to the generation of the analyzed process. If we suppose that the properties of the analyzed process, included in the model, will continue into the future, then the model can be used for prediction.

The extrapolation with time series differs from simple extrapolation. The difference occurs because the time series analysis presupposes that the series whose behavior has to be forecast was generated by a *stochastic (random) process*, whose structure can be characterized and described. In other words, a time series model gives a description of the nature of the (random) process that generated the time series. The description is not carried out in terms of cause-effect, as in the case of the regression model, but in terms of the form in which the event is incorporated into the process.

The time series models can be either deterministic or stochastic. The models that make no reference to the source or random variation of the series are deterministic. A stochastic model of a time series will give more information as a deterministic model, allowing an improved forecast.

The traditional methods of time series analysis suppose that the series are composed of four elements: ***the tendency, the cyclic component, the seasonal component, and random changes***. The first three of the above-mentioned components are deterministic, systematic, whereas the last one is a residual component that provides the analyzed phenomena with the feature of a stochastic process.

The roles of the components in the forecast process are different, depending on the length of the time interval for which the forecast is carried out. In short-term forecasts, the residual component has a major importance. In long-term forecasts, the most important one is the trend component.

A widely used forecasting method is the **exponential smoothing**. The simple version of the exponential smoothing is suitable to the series that do not have an evident trend. The Holt-Winters method is suitable for the series with a strong tendency component.

The **moving average** methods take into consideration the most recent data of a dynamic series. The influence of the recent data decreases with the increasing number of the values (periods) that are used. If the dynamic series has random changes on large time intervals, a larger amount of data will be used. If the dynamic series has a certain configuration and the random changes are abrupt and occur at small time intervals, then a smaller

amount of data will be used. Various versions of moving averages are used: arithmetic moving averages, geometric moving averages, harmonic moving averages, quadratic moving averages, exponential moving averages, weighted moving averages, and double moving averages.

The moving average models are certainly useful, but they offer no information about the trust in forecast, and do not explain the random behavior of the time series. The stochastic models are therefore necessary, because the random component brings information about forecast errors.

The basis for the stochastic modeling is the **stochastic process**. We may suppose that a stochastic process generates the time series. The process consists of an ordered set of random variables that are associated with probability distributions, defined for each of the t time moments. We consider that the series of daily shares' quotations are generated by discrete stochastic process of real values.

The simplest stochastic process, which generates purely random series, is known as **white noise** and consists of a succession of random independent variables, identically distributed, and of zero average. A series is a white noise if it has no known structure (model), and this is why it is non-predictable.

The **random walk** process is frequently used as a model for the stock market quotations. For this particular model all the predictions are equal to the last observed value, and the confidence intervals are higher as the forecast horizon is expanding. A particular version of this process, the random walk with tendency, takes into consideration the existence of a tendency and enables one to include that tendency within the prediction.

The **stochastic model of the moving averages** thoroughly describes the y_t process as the weighted sum of the actual and future random perturbations.

The knowledge of the properties of the series generated by the moving average method is achieved by means of the process of **series autocorrelation**. This means the correlation of a series with its own history (y_t and y_{t-k}, for example).

In the **autoregressive models** y_t depends on a weighted sum of the past values and the term of random perturbation.

There are many random processes for which it is impossible to build a universally valid model through either the moving average or the purely autoregressive model. By integrating the autoregressive and moving average models, the **ARMA** (***M**ixed **A**utoregresive – **M**oving **A**verage Models*) model was obtained. This is deemed to be the most suitable one for economic forecasts, when the evolution of the exogenous variables is unknown. In these models the process y_t is a function of both its own past values, on the one hand, and the past and actual random perturbations, on the other hand.

The identification of ARMA models is based on both the autocorrelation and partial autocorrelation functions, and the informational criteria, used by some of the specialized forecasting software. Some of the informational criteria are *AIC* (*Akaike Information Criteria*), *BIC* (*Bayesian Information Criteria*), *Schwarz* and Φ.

One of the most frequently used and precise analysis and short-term forecast techniques is known as the **Box-Jenkins method,** based on the concept of **ARIMA** (*Integrated Mixed Autoregressive – Moving Average Series*) process.

The *ARMA(p,q)* model is suitable for modeling stationary processes. A stationary process features a process generation mechanism that is invariant in time. The average and the variance of a stationary process do not change in time, and the covariance of the variables depends only on the length of the time interval that separates the two variables. The trend & seasonal components do not occur in stationary series. The non-stationary *ARIMA(p,d,q)* models are specific to the non-seasonal phenomena whose trend can be eliminated, and thus the process can be made stationary, by finite differences of a certain order *d*. The stages of building an ARIMA model are: the identification of the model, the assessment of the parameters, the check-up of the model selected, the utilization of the model for forecast.

The **linear models** are not always sufficient to satisfactorily model real world phenomena. There is an increasing interest in developing, including for modeling time series. Some of the interesting features that the **non-linear models** may offer are: (1) *the prediction interval does not increase in time*, and (2) *the distribution of forecast errors is not a normal one.*

Several non-linear models are frequently used: statistical models of non-linear structure (non-linear autoregressive processes, threshold models, bi-linear models), models for changing variance, and neural networks.

Comparative studies by different authors, between the neural network-based methods, and other methods, showed that:

- automatic application of the neural network process, as a *"black box"*, leads to weak results,
- the neural networks can be applied with satisfactory results only on extended time series,
- for the time being, the effort that the use of neural networks requires (effort in computation, method comprehension and result assessment) appears to lead to insignificant improvements of the forecast results, at least for the moment,
- the neural networks are unable to predict the dramatic changing of the shares' quotations; other factors of influence should be taken into consideration (news about the economic and political situation).

3. Conclusions

There are major differences between the forecasting methods, in terms of their complexity, restrictions, requirements and precision. Each method is appropriate in well-defined circumstances. The selection of the optimal method, which better accommodates to a particular situation and fully values the existing data, is of extreme importance. Without pretending that we exhausted the whole range of shares forecasting issues, we think that the methods we discussed should be present in any study of efficacy concerning the decision of investing in shares.

The forecast activity, performed either by experts or by non-specialists, is almost always computer-aided. All the forecast methods demand a huge calculus effort, and this is difficult - if not utterly impossible - to be carried out manually. The recent development of forecasting and his increasing role, as a fundamental basis for decision-taking, in every field, encouraged the tremendous development of forecasting software. The range of the software used in forecasting goes from general use software such as spreadsheets, to specialized software, which are dedicated exclusively to forecasting.

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VIRGINICA RUSU
NORTH UNIVERSITY OF BAIA MARE
FACULTY OF SCIENCES
DEPARTMENT OF ECONOMICS
ROMANIA
E-mail address: `virginiarusu@yahoo.com`

CRISTIAN RUSU
PONTIFICIA UNIVERSIDAD CATOLICA DE VALPARAÍSO
FACULTY OF ENGINEERING
SCHOOL OF INFORMATICS ENGINEERING
CHILE
E-mail address: `cristian.rusu@ucv.cl`