ASPECTS REGARDING THE THEORY OF EFFICIENT MARKETS

Despa Radu

Romanian-American University, Faculty of Internal and International Commercial and Financial Banking Relations 1B, Expoziției Blvd., Sector 1, Bucharest, Romania , radudespa@yahoo.com, 0744 270 089

Coculescu Cristina

Romanian-American University, Faculty of Computer Science for Business Mangement, 1B, Expoziției Blvd., Sector 1, Bucharest, Romania , cristina_coculescu@yahoo.com, 0740 975 358

Folcut Ovidiu

Romanian-American University, Faculty of Internal and International Commercial and Financial Banking Relations, 1B, Expoziției Blvd., Sector 1, Bucharest, Romania , ofolcut@yahoo.com, 0722 913 416

Abstract: From the beginning of the XX century, in a theoretical paper regarding stock speculation, Louis Bachelier shows that the prices of goods on the stock market fallow a random movement, drawing, from here the conclusion that speculation is an actual game, meaning that neither the buyers or the sellers don't make in whole a net profit. Further statistic analysis seems to confirm the hypothesis of the random movement of exchange rates. So, it was appreciated that the successive changes in the prices at the stock market are practically independent, and the dependents are practically negligible. This means that the fact of knowing these correlations cannot be used to boost profits resulting from operations, the eventual supplemental earnings being canceled by costs. From these reasons, a conception regarding the price movements on the stock market, the so called theory of the efficient market.)

Keywords: efficient market, portfolio theory, informational ensemble

Introduction

Although it dates from the beginning of the XX century, the concept of efficient market has become in the last 30 years the base for researching the theory of financial markets. To Louis Bachelier is owed the model of random movement (steps) "Random Walk" or "Fair Game" revised in 1964 in "The random character of Stock Market Prices" by Paul Cootner. Bachekier showed that the interval in which the stock list can be situated with an established probability, it depends on the current level of the stock list P, on a constant a and on the square root of time $T^{0,5}$, $(P-aT^{0,5}, P+aT^{0,5})$. Assuming a normal distribution of stock lists, constant a can be replaced with the standard deviation for a probability of max 68% and the double of this deviation for a probability of 95%. This rule works only in the hypothesis “fundamental principal” for the evolution of courses, meaning speculation must be a “fair game”, meaning the prices expected by a speculator must be zero.

In 1950 some of the first computer applications in economy were the programs for the analysis of time series. Starting from the premises that, following the evolution in time of some economic variables, one can predict the evolution of economy, the boom and recession periods, the analysis of the evolution in time of the stock list was realized, its evolution showing, in this acceptation, the evolution of economy in its whole. According to the results of the analysis, the stock prices seem to have a random evolution, being unable to predict future prices according to past ones.

In time this characteristic of the market was considered to be a characteristic of “an efficient market” or a market that works “well”. Based on these observations the concept of “random walk” was born, according to which prices lists or past changes, as well as the changes in the output of bonds can’t be used to predict future prices and outputs. According to the model of random walk, the reflection in the stock list of all available information involves the fact that the successive changes of prices and outputs in a period of time are independent. Outputs are also presumed identically distributed. The theory of random walk is incompatible with classical models of administration of portfolios (Markowitz, Sharpe) as well as with the technical analysis on which the hypothesis, that successive price change is constant and that the historical behavior of stock list will repeat in the future, is based on.

The concept of efficient market and the modern theory of portfolios

The developed capital markets have two important characteristics: divisibility (atomicity) and liquidity. Divisibility means that assets are represented by a large number of shares which can be bought for different sums. In consequence an asset can be owned in different proportions by a number of investors and an investor can place his money in more types of shares. Liquidity means that an investor can immediately, without great costs, change some shares with others. This involves the fact that any investor may constitute his portfolio in a way that suits him at any time, very fast and without great cost. He will have the possibility to manage his positions the way he wants. In these conditions the interest of every investor is to obtain information regarding the shares of varied companies quoted on the market. This information will allow investors to evaluate the perspective of every investment opportunity and investing in the portfolio that have the best perspectives. The sources troughs which investors may obtain information are balance sheet, rates and volume of transactions, specialized publications and financial journals, as well as financial institutions that appreciate the perspectives of quoted companies. These information channels are efficient in extent that information is rapidly spreading and all new information becomes public fast.

Because shares are dividable and liquid, investors are in measure to rapidly adapt to the perception changes regarding the value of a company. This new information will lead to buying and selling that will affect the rate of exchange until it corresponds to the new value of the company. Thus, the information will be quickly assimilated by the new rate of the share. For example, if all the investors are sure that the rate of exchange of a share will grow by 5%, they would buy it until this hope of a 5% profit would be reflected in today's rate of exchange. It is because of this that tomorrow's awaited 5% variation will be reduced to 0. Starting from this logic today's rate of exchange becomes a reasonable estimation of tomorrows exchange rate. In these conditions it would be very difficult for an individual investor to find a share that is not correctly evaluated. Thanks to this fact we can formulate a hypothesis according to which the capital markets are "efficient markets". The principal of capital markets efficiency signifies the fact that today's rate is a good approximate for tomorrows rate. Such a process is a "martingale" process. According to this all the necessary information needed for the prediction of future rates are already reflected in the current rates. A special martingale case is the well known process of random roads "random walk", which needs the supplementary hypothesis of the independent distribution of rate variations.

The term of random road is often misinterpreted. Thus, some consider that rate variations are owed to chance and will not have any causal reasoning. The hypothesis of efficient market does not have in view such an interpretation. The rate varies because the characteristics and perspectives of a company in economy change and because of the fact that the evaluation of the investor of these characteristics and perspectives change. In other words, the knowledge of an investor changes with the information that continues to arise and the revisal of the impact of old information. Meaning that at any moment rate variation in the next period is random, being given by the nature of the available information.

Deficiencies in the theory of efficient markets

The premises of the concept of efficient market are:

- Investors are rational, thus they show adversity to risk and want assets that give maximum output for minimum risk;
- Current rates show all the available information;
- Outputs are independent, unlinked at different moments in time with an approximately normal distribution;
- Markets are "random walk" type.

In reality, the premises listed above are not real: investors don't always show aversion to risk, they don't react promptly to information, their guided by trend (built on past information) in present strategies. Because of this, the premises that investors are rational, rate modification is independent and markets are "random walk" can't be accepted. The irregular assimilation of information, as it is in reality, can lead to the *tendency* of random movement- "biased random walk", named *fractal time series*.

The hypothesis of random movement, Brownian, is supported by the following aspects:

- The distribution of outputs isn't perfectly normal;
- The risk of some extreme events is greater than the one supposed by the theory of efficient markets;

- The output has the same distribution regardless of the horizon of time chosen;
- Volatility rises with a greater rate than $T^{0,5,}$ but after a sufficient period of time it drops suddenly.

This drop is based on the growth of the risk premium as the time horizon grows. According to Le Baron, one of the greatest deviations from the pure random evolution in time series is the persistence of volatility. The movements of the output are very hard to predict, although the magnitude of the movements can be relatively easy to forecast. The same author shows in 1992 that self-correlations between share efficiency and the exchange rate change according to recently estimated volatility and the financial time series follow a process whose equation is:

4. $r_t=\lg(p_t)- \lg(p_{t-1})$
5. $r_t=f(\sigma_t^2)r_{t-1}+\varepsilon_t$
6. $\sigma_t^2=\Sigma r_{t-1}^2$.

From these equations results that *f* is a decreasing function of conditional variant, showing the fact that the local predictability in time series is greater in the periods with lower volatility.

Efficient forms of the financial market

The correspondence between the perfect financial market and the financial reality determines the different forms of efficiency of the financial market, respectively operational, organizational and informational. *Operational efficiency* is appreciated in report with the hypothesis of rational behavior of the investors and by their anticipation of the behavior of the other market operators. All of these group behaviors, training effects lead to a certain interpretation of the market reaction trough speculative "bubbles". *Organizational or functional efficiency* refers to the correspondence of hypothesis regarding atomicity, market contingency, and interest without risk, the absence of fiscal and transactional costs. *Informational efficiency* regards the integration in stock rates of fundamental information intrinsic value of quoted shares, public available information, regarding financial execution and the economic perspective of the emitting company, privileged information etc. According to the categories of available information and how quick this information is integrated in the prediction of rates, Eugene Fama identified 3 forms of informational efficiency: weak, semi-strong, strong.

In short, in the hypothesis of efficient market, all the available information, at a certain time, is included in rates. The exchange rate at any moment is an unexaggerated estimate of rates in the following period. On such a market no investor can hope of having, in a repeated fashion, information that has not been already brought up to date by the other investors in the stock. In consequence, no investor can realize abnormal output rates and of a systematic manner. The level of the output rate, at which an investor can hope, is according to the risk assumed by that investor. This remark is very important and represents one of the basic elements of the Equilibrium Model of Financial Assets. The concept of an informational efficient market has a series of extreme implications in the practice of portfolio management: the only investors who have access to privileged information will have the possibility to obtain abnormal earnings. According to Fama (1965; 1969) the information could be separated in three categories, to which three levels of the informational efficiency degree correspond.

Weak form	Semi strong form	Strong form
The informational ensemble: past prices	The informational ensemble: all the public information	The informational ensemble: all the information which are possible to be known
In an efficient market the past prices of shears can't be used to beat the market or to obtain adjusted output for superior risk. Technical and chartist analysis is useless.	Public information include : balance sheets, exploate accounts, PER, capital rise, etc . In an efficient market, in a semi strong form the fundamental analysis, based on the public information, is useless.	Superior performances can't be realized no even by the most susceptible persons to receive privileged information.
Eficient market		

Source: Jacquillat&Solnik (1997)

The technical analysis of securities markets vas developed by practitioners, its values are questioned by the university and research medium. In fact, technical analysis is centered exclusively on the study of the markets internal dates. The idea it's based on is that the economic, financial, psychological factors that influence market rates, are contained in the movements of supply and demand on the market and that the observation of the volume of transactions and the variation of rates is sufficient in anticipating the evolution of exchange rates.

The fundamental hypothesis of technical and charter analysis is that past tends to repeat itself, and certain charter forms, once identified, will provide information regarding future rates. *A statistician will agree with these methods only if the successive rate changes are dependent events*. This is translated by the so called "serial correlation". The inexistence of such a correlation involves a random evolution of rates, known as "random market". The practical use of technical or charter analysis can be verified only after testing the weak form of efficiency. Semi-weak efficiency will exist only if rates reflect all public information, and efficiency in strong form will exist only if rates reflect all information, including the privileged ones. The majority of portfolio management is based on the technical analysis and fundamental analysis in their activity. Accepting the hypothesis of efficient market makes the use of these practices futile [Solnik, 1997]**.** Informational efficiency of the American market was put forward for the first time by Cootner (1964), Moore (1964) and Fama (1965). These studies were followed by Solnik(1973) for the main European markets. Gabriel Hawawini(1985), in his monograph, reviews, in an exhaustive manner, all the efficiency studies on the European markets. All these studies showed the informational efficiency in weak form of the main stock markets. In these conditions the development of new instruments in portfolio management which took shape in the modern theory of portfolios. Some key words, which stand at the base of this theory, are: market model, systematic risk, and stock index, contracts based on indicators, market line, or risk premium. According to this new theory, the investors hope for earnings will be directly proportional to the risk assumed on the market.

Statistic testing of the weak form of informational efficiency

This testing resumes to showing that an investor can't anticipate with a profit, future exchange rates, using past rate sequences. This situation appears when the output of a share can be written, in its simplest form:

$$\tilde{R}_{j,t} = \mu_j + \tilde{\varepsilon}_{j,t} \quad (1)$$

Where $\tilde{R}_{j,t}$ represents the output rate of share *j,* at time *t;* μ_j a constant term, and $\tilde{\varepsilon}_{j,t}$ is a random variable of null hope, the finished variation and of which self-correlation coefficient, with a delay greater or equal to one, is zero.

In these conditions we can write:

$$E\left(\tilde{R}_{j,t} \middle| \mu_j\right) = \mu_j \quad (2)$$

Meaning the best prediction of the output rate of share *j*, for a future period, is its medium output rate, calculated ex-post, on the same period of time.

For the process $\widetilde{R}_{j,t}$, of outputs, to correspond to the weak form of informational efficiency, according to relation (1), there must be fulfilled two conditions:

a) process $\widetilde{R}_{j,t}$ must be integrated by the order 0(the stationarity condition of the process) ;

b) the self-correlation coefficients, of variable $\widetilde{R}_{j,t}$, must not semnificatively differ from zero (serial uncorelation)

a) the integration degree of a process can be tested with the help of Dikey-Fuller test, or the improved version of it ADF. There are proposed the following testing equations:

$$\begin{aligned} \Delta R_{j,t} &= \mu_a + \theta_a R_{j,t-1} + u_t \\ \Delta R_{j,t} &= \mu_b + \theta_b R_{j,t-1} + \gamma_b t + u_t \end{aligned} \quad (3)$$

In case in which residues u_t, are self-correlated by order *p*, Dickey and Fuller proposed the introduction of *p*, regresor $\Delta R_{j,t-i}$, where $i = 1 \ldots p$, resulting the ADF test. The testing equasions will be:

$$\begin{aligned} \Delta R_{j,t} &= \mu_c + \theta_c R_{j,t-1} + \sum_{i=1}^{p} \theta_i \Delta R_{j,t-i} + u_t \\ \Delta R_{j,t} &= \mu_d + \theta_d R_{j,t-1} + \gamma_d t + \sum_{i=1}^{p} \theta_i \Delta R_{j,t-i} + u_t \end{aligned} \quad (4)$$

Studying the distribution of estimates $\theta_a, \theta_b, \theta_c$ and θ_d the two found that they are moving downward in report to the Student, by using Monte-Carlo simulations they found critical values, which tend asymptotical towards the values of the normal law for T>500

When the coefficients $\theta_a, \theta_b, \theta_c$ şi θ_d don't differ significantly from 0, the output series $R_{j,t}$ is integrated by order 1. When it significantly differs from 0 it must be seen if this is not integrated by the order 2, or more. If this last hypothesis is rejected, the output series is integrated by the order zero, respectively stationary.

b) Testing the self-correlation of outputs will be realized with the help of the Ljung&Box(1979), for self-correlation with lag greater or equal to one. The statistic of the Ljung&Box(LB), Q_{LB}, is calculated staring from the self-correlation series with lag between 1 and the forth part of the sample volume. The statistic Q_{LB}, has the following expression : $Q_{LB} = T(T+2)\sum_{j=1}^{K} \frac{\hat{r}_j^2}{T-j}$, where $\hat{r}_j$ are the self-correlation coefficients of residues, of lag *j* . Under the null hypothesis of residues, this statistic is distributed after a law χ^2 , with K degree of freedom.

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