Proceedings of the 15th International Conference on Manufacturing Systems – ICMaS
Published by Editura Academiei Române, ISSN 1842-3183

"Politehnica" University of Bucharest, Machine and Manufacturing Systems Department
Bucharest, Romania, 26 – 27 October, 2006

ANALYSIS OF MARKET PERFORMANCE FOR EVOLVING MARKET EFFICIENCY AND THE IMPLICATION IN MARKETING STRATEGIES

Marius Tudor MUNTEANU, Constantin DOGARIU

Abstract: *In this paper is briefly discussed a classical approaches for testing the market efficiency and define a new test allowing to observe possible changes in efficiency. It were reviewed the main concepts of the dominant academic theory concerning the behavior of future markets, the efficient market hypothesis. This rich conceptual base for finding the best marketing strategies to be able to profit from futures and options trading, and what strategies should be profitable.*

Key words: *market efficiency, marketing strategy.*

1. INTRODUCTION

The term *efficiency* is used to describe a market in which relevant information is imposed into the price of financial assets. Sometimes, however, the economists use this word to refer to *operational efficiency*, emphasizing the way resources are employed to facilitate the operation of the market. Most of this review is concerned with the former definition, namely the *informational efficiency* of the markets.

The concept of market efficiency had been anticipated at the beginning of the 20th century in the Bachelier thesis when this recognizes that *past, present and even discounted future events are reflected in market price, but often show no apparent relation to price changes*. This recognition of the informational efficiency of the market leads Bachelier to continue, in his dissertation, that *if the market, in effect, does not predict its fluctuations, it does assess them as being more or less likely, and this likelihood can be evaluated mathematically*.

2. MARKET EFFICIENCY

The switch of emphasis began with observations such as that *in competitive markets there is a buyer for every seller. If one could be sure that a price would rise, it would have already risen*. Samuelson asserted that *arguments like this are used to deduce that competitive prices must display price changes... that perform a random walk with no predictable bias*.

Since the pioneering theoretical work on the Efficient Market Hypothesis, a large number of empirical and theoretical studies examining market behaviour and testing efficiency of developed equity markets have appeared. The concept of *efficiency* has changed over time. A great contributor distinguished among *weak*, *semi-strong*, and *strong* form of efficiency, according to an explicitly defined informational set which could be considered by earning superior returns. Summarizing the methodology of empirical studies, tests which have been carried out can be divided into two groups: tests of *asset pricing models* and tests of *market efficiency*.

The first group of tests seeks to determine whether share price behaviour conforms to the Capital Asset Pricing Model.

The second group of tests seeks to determine whether the pattern of changes in the share price of common stocks is consistent with the notion of an efficient equity market, *i.e.*

The distinction between tests of *asset pricing models* and tests of *market efficiency* is made only for the purpose of exposition. Tests of pricing models, in some sense, are also tests of *market efficiency*, and tests of *market efficiency* are usually carried out assuming a model of asset pricing.

The theory involves defining an efficient market as one in which trading on available information fails to provide an abnormal profit. A market can be considered to be efficient, therefore, only if is posit a model for returns.

The *weak* form of the efficient market hypothesis claims that prices fully reflect the information implicit in the sequence of past prices.

The *semi-strong* form of the hypothesis asserts that prices reflect all relevant information that is publicly available, while the *strong* form of market efficiency asserts information that is known to *any* participant is reflected in market prices. The literature begins, therefore, with studies of weak form market efficiency.

The early random walk literature contained in the historical sequence of prices, concludes that *the results are strongly in support* of the *weak* form of market efficiency. A number of *semi-strong* and *strong* form tests conclude that *in short, the evidence in support of the efficient markets model is extensive, and (somewhat uniquely in economics) contradictory evidence is sparse.*

The tests for market efficiency can differ from a technical point of view, they have one common trait - they look at the long-run market characteristics. For instance, an examination of autocorrelation coefficients, variance ratios, or testing for long-range dependence allows measuring the market predictability as a property steady over some predefined period.

More precisely, when is described the classical definition of market efficiency, say that a market is *weak-*

form efficient when there is no profit opportunity based on the past movement of asset prices. It can be tested with the equation

$$r_t = \beta_0 + \sum_{i=1}^{p} \beta_i \cdot r_{t-i} + e_t, \quad (1)$$

where r_t is the rate of return on the asset at time t. If the market is efficient all the β_i, $i > 0$ coefficients should be equal to zero. In the financial literature is well documented that the error process of financial securities returns does not often prove to have a full set of N properties. In particular, if the variance of the error process is changing over time in a systematic way, this will cause problems for the testing procedure and it may also affect the required rate of return. If the changing variance structure is omitted and there is a serial correlation, then again we may find spurious correlation and thus incorrectly reject market efficiency. This case can be dealt with by combining equation (1) with a standard model, *i.e.* by adding the volatility term in the following way:

$$r_t = \beta_0 + \sum_{i=1}^{p} \beta_i \cdot r_{t-i} + e_t + \delta h_t, \quad (2)$$

$$h_t = \alpha_0 + \alpha_i h_{t-1} + \alpha_2 e_{t-1}^2, \quad (3)$$

with $e_t \sim N(0, h_t)$.

One might consider the question of how to modify this method to get information about possible changes in weak-form efficiency over time.

For instance, one might try to use a technique of "slowly" moving windows of a certain length and in this way divide the whole period in question into a finite number of sub-periods. Then one might estimate all the parameters required by equations (2) and (3) for each sub-period individually. In this approach, however, the length of a window is crucial and significant for the power of the estimated values. Moreover, we should note that such an approach causes the loss of some observations at the beginning and at the end of the investigated period.

In conventional economics, markets are assumed to be efficient if all available information is reflected in current market prices.

Economists have summarized some form efficiency tests as: *weak*, *semi-strong* and *strong* efficiency tests. The *weak*-form tests investigate whether market prices actually reflect all available information.

The *semi-strong* tests are based on so-called event studies, where the degree of market reaction to "news announcements" is analyzed.

The *strong*-form tests analyze whether specific investors or groups have private information to take advantage of.

Many studies conclude that the major markets are efficient and that all information is reflected in current prices. However, the conclusions of such studies have been oriented by methodological questions; in particular, whether any observed departures from market efficiency are due to any original market inefficiency or a deficiency of the market pricing model being used as a etalon to compare actual with theoretical prices.

The conclusion that in an efficient market no excess return can be generated with trading models is based on the assumption that all investors act according to the rational expectation model. If this assumption is wrong, the conclusion that forecasting is impossible is also questionable. The assumption of rational expectations has been called into question by many economists. The idea of heterogeneous expectations has become of increasing interest to specialists.

Attention has also been caught by the possibility of time-varying expectations, which is closer to our view of the market.

Variation in expected returns over time poses a challenge for asset-pricing theory because it requires an explicit dynamic theory in contrast to the traditional static capital asset pricing model.

In summary, the conclusion that financial asset prices are not predictable is based on three assumptions: that market price reflects all the information available, that news and events hitting the market are normally distributed and that the market is composed of homogeneous agents.

Introducing the heterogeneity of agents can give rise to very interesting nonlinear effects in the models.

It is important to find a good measure of how well a market operates. From a dynamic perspective, the notion of reduced friction should be central to the notion of efficiency.

An efficient market is considered to be a market where all market information must be available to the decision makers and where there must be participants with different time scales and heterogeneous expectations trading with each other to ensure a minimum of friction in the transaction costs.

A quantitative measure of efficiency might be derived from the bid–ask spreads (the spreads between real bid and ask prices being more appropriate than the nominal spreads quoted in information systems). The probability of extreme price changes within short time intervals should be considered together with the spread, in the quantitative measure of market efficiency to be proposed.

It is important to find a good measure of how well a market operates. This is why, in view of our results, we would like to suggest some ideas for a redefinition of *efficient markets*. From a dynamic perspective, the notion of reduced friction should be central to the notion of efficiency.

We consider an efficient market to be a market where any investor can find a matching partner for any transaction any time at a price which is not influenced by information hidden from any partner.

In other words, a market may be termed efficient if the following two requirements are met: First, all market information must be available to the decision makers. Second, there must be participants with different time scales and heterogeneous expectations trading with each other to ensure a minimum of friction in the transaction costs.

3. THE RANDOM WALK MODEL

For a better understanding of price formation in competitive markets, the random walk model came to be seen as a set of observations that can be consistent with the efficient markets hypothesis.

In finance, this analogy has been applied to series whose successive returns are serially independent researchers were, for the first time, able to use electronic computers to study the behaviour of infinite price series. The assumption of economists was that one could *analyze an economic time series by extracting from it a long-term movement, or trend, for separate study and then scrutinizing the residual portion for short-term oscillatory movements and random fluctuations*. Nevertheless, these empirical observations came to be named the *random walk model* or even the *random walk theory*. Trading strategies, differ when returns are characterized by random walks or by positive autocorrelations (or persistence) over short horizons and negative autocorrelations (or mean reversion) over long horizons. Random walks in stock returns are crucial to the formulation of rational expectations models and the testing of weak-form market efficiency. In an efficient market, the prices of stocks fully incorporate all relevant information and hence stock returns will display unpredictable (or random walk) behaviour. In stock prices not characterized by a random walk, the return generating process is dominated by a temporary component and therefore future returns can be predicted by the historical sequence of returns. The ability of stock markets to play the role that is usually ascribed to them – attracting foreign investment, helping domestic saving and improving the pricing and availability of capital – depends upon the presence of random walks. A market following a random walk is consistent with equity being appropriately priced at an equilibrium level, whereas the absence of a random walk infers distortions in the pricing of capital and risk. This has important implications for the allocation of capital within an economy and hence overall economic development.

An efficient market is one that accurately incorporates all known information in determining price. Fama's definition came to be known as the efficient market hypothesis (EMH). It essentially extends the zero profit equilibrium of a competitive market in a certain world to an uncertain world of price dynamics. Although considerable disagreement exists about the degree to which EMH holds, it has become the dominant paradigm used by economists to understand and investigate the behaviour of financial and commodity markets.

The following equation allows a simple discussion of the major concepts underlying the EMH:

$$P_{t+1} = a + ßP_t + e_t, \tag{4}$$

where P_{t+1} is the price at time $t+1$, P_t is the current price, a and ß are parameters, and, et is a random error term which is independently and identically distributed with mean 0 and constant variance s^2. To aid in understanding EMH, equation is rearranged as follows:

$$P_{t+1} - ßP_t = a + e_t. \tag{5}$$

If $a = 0$ and ß = 1, then

$$P_{t+1} - P_t = e_t. \tag{6}$$

Last equation yields:

$$E_t(P_{t+1} - P_t) = 0. \tag{7}$$

The price process described above is usually referred to as a random walk.

4. THE TEST FOR EVOLVING EFFICIENCY

To test for possible changes in market efficiency we need a tool which will allow us to do the following: first, it will allow us to, at least, check for weak form efficiency; second, it will be able to detect changes in efficiency over time; and third, it will operate within stochastic series for which the error process can have the variance changing over time in a systematic way, *i.e.*, the error process does not prove to have a full set of *N* properties. To attain all these requirements we suggest modifying equations (2) and (3) by adding a time subscript to the β_i coefficients and defining a set of p equations describing behaviour of the β_i coefficients themselves. Then, we receive

$$r_t = \beta_{0t} + \sum_{i=1}^{p} \beta_{it} \cdot r_{t-i} + e_t + \delta h_t, \tag{8}$$

$$h_t = \alpha_0 + \alpha_i h_{t-1} + \alpha_2 e_{t-1}^2, \tag{9}$$

$$\beta_i = \beta_{i-1} + v_i. \tag{10}$$

Such a model may be estimated using the standard Kalman Filter approach, with equation being the measurement equation, and the set of state equations defined by previous equations. The parameters required to estimate time paths of β_i, like δ, α_0, α_1, α_2 and all p values of σ_I^2 can be found by computing and maximizing some probability functions.

5. IMPLICATIONS OF MARKET EFFICIENCY FOR MARKETING STRATEGIES

Using the efficient market hypothesis as conceptual foundation, organize the empirical research on market efficiency according to a classification of strategies employed in the marketing of industrial products. The different strategies employed are: routine strategies, systematic strategies, strategies based on individual-generated forecasts, and strategies based on market-generated forecasts of profits from engaging in a production activity. A *routine strategy* is one that involves buying or selling at the same time during each production cycle. Because of their passive and unconditional nature, routine strategies represent minimal input strategies. These attributes make the evaluation of routine strategies important because the routine strategy which yields the highest return becomes the benchmark against which active and conditional marketing strategies should be measured. One obvious routine strategy is to sell 100 percent of production at the end of the production period. Another routine strategy that has received significant

attention is to always sell a share of expected production before production. Such a strategy will enhance income if exists $u < 0$ and $v = 1$. On the other hand, if the futures or options market provides an unbiased forecast of subsequent prices (*i.e.*, $u < 0$ and $v = 1$), then the expected return from selling before harvest is zero. Hence, the success of routine selling before production depends on whether a routine price bias exists.

Systematic Strategies base the buy/sell decision on the status of an indicator variable. The indicator variable can take on different values over time. Depending on the value of the indicator variable, the strategy may involve taking a long, short, or no position, with the exact position changing as the value of the indicator variable changes. In terms of the discussion of price bias in an efficient market, these strategies are consistent with a situation in which u can take on any value, but $v = 1$, and the relationship between u and the indicator variable is caused by a risk factor. Thus, for successful systematic strategies in an efficient market, the risk factor must vary over time. A systematic strategy which has received considerable attention in the literature is based on the argument that a hedging pressure risk premium exists. This argument was first stated by Keynes and Hicks. It is based on the assumption that producers engage in avoiding to reduce risk. Assuming that speculators are risk-averse, they will assume the risk which hedgers want to transfer only if they are paid for accepting it. Normal backwardation is a mechanism by which hedgers of cash industrial products pay speculators to assume the price risk avoided by avoiding. By analogy, a contango is the mechanism by which long hedgers pay speculators to assume the price risk avoided by hedging. These arguments imply that a long position will be profitable if hedgers are net short, while a short position will be profitable if hedgers are net long.

Marketing Strategies Using Individual-Generated Forecasts model of market efficiency implies that positive trading returns can be earned by those who are the first to acquire new information or who possess superior analytical ability. As discussed earlier, positive returns can be earned because information is costly and because markets are human institutions and, thus, need to learn (*i.e.*, analyze) new information. Hence, v in the price bias equation may not equal 1. Large traders, especially those involved in producing or transforming commodities are immersed in national and international information flows. They also have access to more resources than small traders. Because of these advantages, the model implies that large traders should make most of the money from trading on futures and options markets. In contrast, because of their limited ability to be among the first to acquire new information, small traders should lose money as a group.

Marketing Strategies Based on Market-Generated Forecasts of Production Profits use the currently-quoted futures and options prices to forecast the expected profit from engaging in a production activity. The expected profit is used to determine a production and associated hedging (*i.e.*, marketing) strategy. This category of strategies is derived from viewing the futures and options prices as forecasts which carry signals regarding production activities the market wants to encourage or discourage. Stated alternatively, these strategies are derived from using the collective wisdom of the market to guide activities, rather than trying to increase price by outguessing the market's wisdom.

6. CONCLUSIONS

In this paper it were extended the classical test for autocorrelation of returns by combining a multi-factor model with time varying coefficients approach to investigate evolving market efficiency. It was developed the basis that will be successfully verified using some tests by employing simulations. The application of these test were already applied in some researches using computer simulation for an investigation of the first stages of a market for industrial products performance. The results will be presented in detail in a future paper.

REFERENCES

[1] Zalewska-Mitura, A., Hall S. G. (1998). *Examining the first stages of market performance. A test for evolving market efficiency*, Discussion Paper No. 11–98, Centre for Economic Forecasting, ISSN 0969-6598, London.

[2] Chen, P. (1996). *A Random Walk or Colour Chaos on the Stock Market? Time-Frequency Analysis of S&P Indexes*, Studies in Nonlinear Dynamics and Econometrics, vol. 1, no. 2, The MIT Press, ISSN 1081-1826.

[3] Seiler, M. J., Rom, W. (1997). *A historical analysis of market efficiency: Do historical returns follow a random walk?*, Journal of Financial and Strategic Decisions, vol. 10, no. 2.

[4] Pesaran, M. H., Timmermann, A. (1994). *Forecasting Stock Returns. An Examination of Stock Market Trading in the Presence of Transaction Costs*, Journal of Forecasting, no. 13, pp. 330–365.

[5] Frederick, E., Webster, Jr. (2005). *A Perspective on the Evolution of Marketing Management*, Journal of Public Policy & Marketing, vol. 24 (1), pp. 121–126.

[6] Burton, G., Malkiel, (2003). *The Efficient Market Hypothesis and Its Critics*, Journal of Economic Perspectives, vol. 17, no. 1, pp. 59–82.

Authors:

Drd. eng. Marius Tudor MUNTEANU, General Manager, S.C. Mecanica Ceahlău S.A., Piatra Neamț.
Prof. dr. eng. Constantin DOGARIU, "Politehnica" University of Bucharest, MSP Department.