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Market Efficiency and Information: A Literature Review

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Abstract: This article tries to examine the efficiency market hypothesis. Therefore, the efficiency is studied through endogenous and exogenous information. The goal of this paper is to describe the literature review the most exhaustive of efficiency studies. We show that distinct conclusions can be emphasized following the type of analyzed information. Consequently, the endogenous information is not of quality to question the efficiency, rather than the exogenous one shows significant results. The exogenous information allows forecasting future stock returns, and earning profit. It is getting a decision making tool.

Keywords: efficiency market, endogenous information, exogenous information.

JEL Classification: G00, G14

Introduction

The theory of stock market efficiency, as defined by Fama (1970), according to which «*a market is efficient if prices of the securities fully reflect not only all the information available but also all publicly available information»,* has been one of the most studied theories in the last 40 years. Fama determines several conditions: there are no transactions costs in trading securities, all available information is costlessly available to all market participants, and all agree on the implications of current information for the current price and distributions of future prices of each security. In such a market, the current price of a security fully reflects all available information. Consequently, the analysis of efficiency consists in testing this definition. The financial theory indicates that the challenging of efficiency requires that the non-predictability of returns is jointly verified, as well as the potential to beat the market. If both conditions are met, the market is considered to be inefficient.

In his definition Fama has used the important notion of *"available information"*. He has took into account the informational context as a whole which reveals itself to

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be too general and too wide for empirical verification. Consequently, the author has made a distinction between three types of efficiency, according to the type of information incorporated in prices or to the information contained in this informational whole.

- The weak form: prices of the securities instantly and fully reflect all information of the past prices.

Tests for the weak form efficiency are random-walk tests. They attempt to predict future returns on the basis of past returns.

- The semi-strong form: asset prices fully all of the publicly available information.

Studies examine the speed of price adjustment to the announcement effect (stock splits, annual reports …).

- The strong form: asset prices fully reflect all of the public and inside information available.

This form will not be examined in this paper.

Faced with so many studies, Fama (1991) had changed the categories. The semi-strong form (and strong form) changed its name to Event studies tests. The weak form was become tests for return predictability.

More recently, authors have suggested a new classification. It is in fact a change of name. It includes parameters for the identification of information under analysis. Now, efficiency is examined both on the basis of information contained in prices, and on its origin. Orléan (1989), Walter and Brian (2008) stipulate that a financial market is defined by its capacity to convert information into price. Walter (1996), Walliser (2000), Monino and Matouk (2005), Orléan (2008), Walter and Brian (2008) differentiate information on a financial market according to its origin, either in relation to the market itself (endogenous) or, on the contrary, out of the market (exogenous).

First of all, "endogenous" information[1] gathers all data collected from the market itself. These are quantitative data: time series for yields (prices, volatility, etc.), market financial and economic variables (exchange rates, etc.), trade frequency and the trading volume. All these elements are contained in the weak form. Endogenous information includes the weak form of efficiency and merges all the particular aspects of a financial market, such as volume and historical stock prices. These pertain to information inside markets, summarized under the designation of endogenous information, which means information relative to the market operators and to their specific exchange conditions.

Then, "exogenous" information[2] relates to public - or made public - information, similarly to the semi-strong form. These are qualitative data, published by a transmission channel called the media. It includes macroeconomic indicators for the sector concerned (such as commercial previsions, the social context, etc.) but also microeconomic data on the firm concerned (profits, changes of Directors,...), or with regard to the firm's sector (mergers, competitors acquisition, new technology,...). Exogenous

information refers with an economic reality, the environment, the social context, the classic elements for financial analysis, the commercial reality.

The analysis of efficiency, according to endogenous or exogenous information, is similar to the weak form or the semi-strong form. Nevertheless, it indicates immediate and clearer on the nature of information (quantitative or qualitative) but also on their origin (inside or outside of the market), in the light of the available information. This change of terminology is certainly a definite improvement in the way the analysed informational content in the *"set of available information"*, is apprehended, just as Fama (1991) had previously done.

The empirical literature has mostly focused on the validity of the efficiency hypothesis, on the basis of an accurate econometric analysis for a particular type of informational content. We are thus reviewing the results of the main techniques used with regard to the efficiency hypothesis according to the examined informational content. The aim of this article is to make a survey of the research studies, methods and especially results on efficiency tests of the past 40 years. To this purpose, we shall examine efficiency on the basis of information used on the market (endogenous or exogenous), rather than the forms of efficiency (weak and semi-strong). The analysis of efficiency according to information rather than Fama's forms is merely a change of terminology. On the other hand it allows better understanding of the type of information being examined.

Research studies have examined efficiency on the basis of endogenous information, through predictability tests on returns, variance ratios, long memory, and seasonal bias or on trading volume analysis. Each of these analyses is carried out with a specific econometric method which has evolved and strengthened with the successive authors. In the case of exogenous information, the evolution has been quite different. The method of analysis has remained unchanged since the first research studies on the topic of announcement effects. All these studies are always undertaken in the context of specific events. To this purpose, they use data from a great number of firms in order to study the announcement effect. Recently, some innovative research studies have broadened the scope of previous analyses. They have worked on manifold exogenous information, and no longer on the basis of a few announcement effects. They introduce an informational analysis to identify the informative content. The authors classify the different types of exogenous information according to the notion of *'informative coloration'* defining the impact of exogenous information on returns. These authors show that the market does not immediately assimilate exogenous information into stock returns. These results significantly challenge efficiency with regard to exogenous information.

Few research studies make a comparison on the evolution of each technique and the results which all these tests have highlighted. It is indeed difficult to contrast analyses according to the informational type studied. Econometric methods are very different since, either quantitative or qualitative data is studied. Consequently, we shall investigate the evolutions in the methods used in each informational type, which will enable us to compare results. A more precise conclusion should be ob-

tained on the efficient market hypothesis. Indeed, it appears that depending on the type of information, results overlap. Thus an identical conclusion has arisen within each informational type examined. However, these results are different when the information is endogenous or exogenous. Is it possible that a type of information be more informative in the analysis of efficiency? It appears that recent work provides us with stimulating ideas. According to Brian and Walter (2008), exogenous information alone is relevant with respect to security value, which rejects the efficiency hypothesis. Exogenous information enables judgments to feed reasoned opinions on a firm's true value. It represents the outcome of analyses achieved by economists and financial specialists. Whereas endogenous information cannot be used for the purposes of building on a firm's value. It is akin to chartists' techniques and contributes to random speculative behaviours.

Following this first introductory section on the informational efficiency of stock markets, in the following section we investigate research studies on efficiency in relation to endogenous information. Here, forecasting tests of stock prices through random walk or weak form tests are re-examined. These verify that daily price changes are not self-correlated and that they are completely unpredictable. Then, studies in contemporary relationships examine whether trading volumes lead price changes. Lastly, the various seasonal effects are broadly revisited. We prove that a clear indication emerges from analyses on endogenous information. Indeed, the results confirm market efficiency. In the third section, exogenous information is analysed. These are event studies and their recent developments. We highlight early work investigating multiple information as well as statistical techniques which link a value to the information in order to provide an indicator for the agents' decision making. Here again, a clear indication emerges from the study of exogenous information. Indeed, results show that the analysis of this information helps to anticipate future evolutions in stock prices. Moreover they are conducive to beating the market. They satisfy the two necessary conditions for challenging efficiency. Finally, a last section concludes the paper.

Efficiency with Endogenous Information

Following our introduction, there are two sources of information available for the purposes of evaluating the level of stock prices as well as decision making. This distinction is of two respective parameters such as the origin and location of production. Endogenous and exogenous information respectively represent new information from elements arising from internal and external components, with an effect on them in all cases.

An "endogenous *information"* is an information which originates from, and solely from, the market itself. Agents intervening on the market are aware of agents' intentions through asset prices and trading volume. The study of efficiency as a function of endogenous information has been very important, ever since Fama's research.

It is possible, however, to gather analyses on efficiency into 4 groups where three are focused on prices or volatility and the last on volume. The first group is related to random-walk tests. We then address studies concerning long memory and seasonal effects and later the analysis of trading volume. The latter has been neglected by the literature for a long time but the evolution of econometrics has renewed interest in this area. Data are of qualitative nature. All of these analyses aim at predicting the evolution of returns. In this overview of efficiency, we show that from the analysis of endogenous information, a common conclusion can emerge.

The Random-Walk Test

This is one of the most adopted tools, during the past 20 years, to test the efficiency hypothesis. Indeed, Fama and French (1988) have pointed out that between 25% and 40% of long term variation is predictable from past returns. Lo and MacKinlay (1988) have developed a variance ratio as an essential econometric element to test the random-walk test hypothesis. These authors use the random-walk equation, of which one of the properties is that the variance of these increments is linear: $\mathrm{var}\left(x_t\right) = t.\sigma^2$. These use two maximum likelihood estimators, that are unbiased and consistent of the estimated variance, $\bar{\sigma}^2\left(1\right)$ which is the difference between $x_t - x_{t-1}$, and $\bar{\sigma}^2\left(q\right)$ being the difference between $x_t - x_{t-q}$, with $q > 1$. The variance ratio is expressed as: $\overline{V}_r(q) = \dfrac{\overline{\sigma}^2(q)}{\overline{\sigma}^2(1)}$. A ratio equal to 1 indicates a random-walk; inferior (superior) to 1 confirms the existence of negative correlation series (positive).

Their variance ratio is robust in the presence of heteroscedasticity, thanks to the estimator by Newey West (1987), aiming at a normal distribution. The statistics of the variance ratio test denoted: $Z^*(q) = \dfrac{\overline{V}_r(q) - 1}{\sqrt{\Phi^*(q)}} \xrightarrow{a} N(0,1)$, with $\Phi(q) = \dfrac{2(2q-1)(q-1)}{1wT}$, is always asymptotically normally distributed. The variance ratio test is calculated for each of the intervals, *q = 2, 4, 8, and 16*.

Chow and Denning (1993) have resumed this research and pointed out that failing to control the test size for variance ration estimates result in large Type I errors. According to these authors, the random-walk null hypothesis was rejected too easily. They suggest changing the way to proceed by using the maximum absolute value of Lo and MacKinlay's (1988) tests for set ratios of estimated multiple variance $\left\{q_i \,\middle|\, i = 1,2,...m\right\}$. The authors thus define a confidence level for a set of variance ratio test statistics. Beginning with Bonferroni's unequal probability, they established that the multiple variance ratio test statistics is based on the *'Studentized Maximum Modulus'*distribution, and not on a conventional standard normal distribution. The ratio becomes $Z1^*(q) = \max_{1 \le i \le m} |Z^*(qi)|$, such as $Z1(q) \xrightarrow{a} SMM(\alpha, m, \infty)$ follows a '*Studentized Maximum Modulus*' distribution.

The evolution observed from the variance ratio test statistics between these two methods does not show any change in econometric test procedures. These two methods are identical and variance ratio statistics give the same result. The only real difference resides in the use of a statistical table for different decision rules. The critical values from Stoline et Ury's tables (1979) being greater than those of the conventional standard distribution, it becomes more difficult to reject the random-walk null hypothesis.

This test has been widely used in many financial studies. For the NYSE (Lo et MacKinlay, 1988; Chow et Denning, 1993), results with the two parametric variance ratios show that the random-walk null hypothesis cannot be rejected. These results are confirmed for the Dow Jones (Fama et French, 1988) and all largest stock markets in the world[3] (Gallagher, Sarno and Taylor, 1997). Stachowiak (2004) confirm these results for the CAC40 and MIDCAC indexes in the French market. Ojah and Karemera (1999) have visited latin american countries[4]. These authors also point out that all series follow a random-walk.

More recently, Wright (2000) and Colletaz (2006) built a non-parametric variance ratio based on signs from stock returns. Let $r(x_t)$ be the rank of x_t among $x_1,...,$ x_T, and the standardized series r_{1t} with zero mean and of unit variance. Wright substitutes r_{1t} for x_t in his definition of the test $Z1_q$ such as the test is proposed as being: $R_1(k)=\left(\frac{\sum_{k+1}^{T}\left(r_{1t}+\cdots+r_{1t-k+1}\right)^2}{k\sum_{1}^{T}r_{1t}^2}-1\right).\left(\frac{2(2k-1)(k-1)}{3kT}\right)^{-1/2}$. Colletaz (2006) shows that variance ratio tests based on ranks do not suffer from serious distortions in the presence of heteroscedasticity. He suggests a multiple variance ratio to better consider heteroscedasticity: $\left|ZR(m)\right|=\max_{1\le k\le m}\left|R_1(k)\right|$. The test procedures correspond to that of Lo et MacKinlay (1988). Wright's (2000) original and innovative approach raises some difficulties in finding research applied on the parametric ratio. The results from the variance ratio, however, are identical, whatever the method used.

Despite the econometric evolutions in the variance ratio test, using this test to verify the efficiency hypothesis provides us with an anonymous conclusion. Indeed, the results do not allow us to call into question the notion of efficiency. First of all, the random-walk null hypothesis cannot be rejected for the main financial markets whatever the ratio used. Moreover, these tests do not give neither any relevant information on use for provisional purposes, nor on any opportunity of implementing a decision-making strategy to beat the market.

The Long Memory Test

The presence of long memory is a source of market inefficiency. This presence is manifested in a chronological series with an autocorrelation which decreases hyperbolically as the lag increases (McLeod et Hipel, 1978). Indeed, long memory has a non-integer

differentiation parameter. It opens the way for long-term fractional model of the ARFIMA or FIGARCH types. It thus seems possible to predict returns from past returns.

The emergence of long memory was carried out using two techniques. The first econometric technique is motivated by the log spectral density. The integration parameter denoted *d,* is estimated from the regression of the least squares close to zero. Thus, we have: $\ln\{I(\lambda_{j,n})\}=\alpha-d\ \ln\{4\ \sin^2(\lambda_{j,t}/2)\}+e_j$. With, α a constant, $\lambda_{j,T}=\frac{2\pi j}{T}$, $j=0,...,T-1$ being the harmonics, and $\lambda_{j,t}$ the periodogram. The estimation of the parameter $d=\frac{\sum_{j=1}^{n}\left(y_j-y\right)\ln\left\{I\left(\lambda_{j,T}\right)\right\}}{\sum_{j=1}^{n}\left(y_j-y\right)^2}$, where $y_t=\ln\{4\sin^2(\lambda_{j,t}/2)\}$.

Geweke Porter Hudak (1983), have indicated that the number of ordinates (*m*) of low frequencies to be considered is important. An ordinate with a value too high will contaminate *d* with mid to high frequency components. A value that is too low will lead to imprecise results due to degrees of freedom which are limited in the estimate. In order to reduce this problem, Robinson (1995) therefore estimates the integration parameter *d*, based on a modified version of the log-periodogram. The author modified the form of the regression. He uses a multivaried periodogram by introducing a dimension vector. Under the hypothesis of the gaussian process, it thus appears that the estimator has convergence and asymptotic normality properties.

The results, following the method by Gewele Porte Hudak (1983) or that revisited by Robinson (1995), converge. Mills (1993) inquired the British market from 1965 to 1990; Ojah and Karemera (1999) studied four Latin equity returns (Argentina, Brazil, Chili and Mexico) for a recent period of 10 years; and Henry (2002) examined long term dependence for nine great international markets[5] from 1982 to 1998. The results by these authors do not show the presence of long memory, the statistics are not significant.

The second method is a result of Hurst's (1951) research and further developed later by Mandelbrot (1972) then by Lo (1991). It is called the Hurst statistics. The first econometric works undertaken by Hurst aimed at building a dam to regulate the flow of the river Nile. The *R/S* is the range of partial sums of deviations of a time series from its mean, rescaled by its standard deviation. Its capacity is equal to: $R\left(t,n\right)=\max_{0\le k\le T}\sum_{j=1}^{k}\left(X_j-\bar{X}_t\right)-\min_{0\le k\le T}\sum_{j=1}^{k}\left(X_j-\bar{X}_t\right)$. The first term in brackets is the maximum of the partial sums of the first *k* deviations of X_j from the sample mean. Then, Mandelbrot (1972) examined these first findings to apply them in the context of financial series. He demonstrated that the marginal distribution was non-normal, the confidence level in terms of range $R(t,n)$ to measure the Hurst coefficient could lead to erroneous results. The author proposed a rescaled range statistics, using the standard deviation, such as $R(t,n)$ is standardized by: $S\left(t,n\right)=\sqrt{n^{-1}\sum_{j}\left(X_j-\bar{X}_n\right)^2}$. It thus pro-

vides the *R/S* statistics or Hurst exponent: $H = \frac{\log\left({}^{R}/_{S}\right)}{\log(n)}$, one of the most commonly used tools to highlight the presence of long memory in financial returns. Lo (1991) examined Mandelbrot's *R/S* statistics and noted its great sensitivity to dependence in the short term. He concluded that the estimate of an integration parameter through Hurst exponent could wrongly bring about the conclusion of a long term dependency whereas the process structure is actually only of a short term structure. Moreover, the *R/S* statistics are not a statistical test, since there is no evidence of a normal distribution. In the econometric statistical extension of Hurst and Mandelbrot's study, Lo (1991) therefore defined the *R/S* modified statistics, which not only takes into account an estimator of the variance such as Mandelbrots' but also auto-covariances, so as to reduce to a minimum the impact of short term dependencies. He thus defines the *R/S* modified statistics, denoted $Q_n \equiv \frac{1}{\hat{\sigma}_n} \underset{1\le k\le T}{Max} \sum_{j=1}^{k}\left(X_j - \bar{X}_t\right) - \underset{1\le k\le T}{Min} \sum_{j=1}^{k}\left(X_j - \bar{X}_t\right)$, where $\hat{\sigma}_x^2$, $\hat{\gamma}_j$ are the usual denominators of the variance and the auto-covariance. Moreover, he demonstrates that Hurst exponent converge in its distribution to a random variable *V*. These statistics can therefore be examined as a truly econometric test from the point of view of a decision-making principle, which was not the case with Mandelbrot's unique value.

Empirical studies have shown different results depending on the techniques used. Indeed, Mandelbrot's Hurst statistics support the presence of long memory. Both Mills (1993) for the British market[6], and So (2000), for the American market[7] (through the entire Dow Jones and SP500 individual index), confirm the presence of long memory. Resultas are different with Lo's statistics. Lo (1991) tested his statistics on the basis of data from the NYSE (from 1962 to 1987), and Lux (1996) on the DAX German index. The authors show that there is no long term dependence. Lastly, Mignon (1998) carried out a full study on seven major international financial marketss[8]on a 25 year period with the *R/S*statistics, and observed the presence of long memory for several series. She cannot confirm the long memory results with the modified R/S statistics. Thus, the markets do not show evidence of long memory. Matouk and Monino (2005) have studied AC40 indexes returns. They used the Bootstrap technique to give a confidence interval for the calculated Hurst coefficient. The calculated value of this Hurst coefficient for monthly data is 0.6, which is slightly higher than the confidence interval. The results show that returns are non-gaussian.

A necessary condition of the efficient hypothesis should be recalled. Indeed, Fama's informational efficient model (1970) is based on the random-walk process. This implies a property on the distribution of price changes. This explanation was brought forward by Bachelier in 1991, who was the first to make the assumption that transaction were independently and identically distributed (*i.i.d*), with finite variance. Thus, the central limit theorem lead us to suppose that price changes have normal or gauss-

ian distributions. The hypothesis indicates a normal random-walk process *i.i.d* with finite variance. This thus presupposes a histogram representing a mean of zero and constant variance. The graphic representation is symmetrical, with a null skewness coefficient. Its flattening is normal, with a Kurtosis coefficient below 3. Lastly, the histogram representation does not have distribution tails, this being the homoscedasticity hypothesis which is introduced by stock market variations of the *i.i.d* type (constant variance). All the models previously discussed use this hypothesis.

However, ever since the works of Mandelbrot (1963) ... through to Lardic and Mignon (1998), Walter (2001) and Matouk and Monino (2005), empirical evidence has shown that returns do not take normality into account. Mandelbrot (1963) indicated that the histogram representation shows distribution tails as well as kurtosis coefficients greater than 3. The presence of heteroscedasticity implies that the variance is not finite and that the normal distribution is not adequate to account for market returns. The normal distribution curve does not allow covering the entire distribution. There are rather thick distribution tails, but especially larger than that of the normal distribution. This phenomenon, called *'leptokurtic'*, recognized by the entire literature, invalidates part of the standard model. Moreover, the Skewness coefficient reveals asymmetry in returns. Thus the statistics for verifying distribution normality by means of Jarque Bera's test is, in all cases, rejected.

Moreover, Box and Jenkins developed the linear models in the 70's, thanks to their algorithm and Wold's decomposition which formed the basis of their efficiency model. But at the same time, Ruelle and Takens highlighted the phenomena of deterministic chaos, from Lorenz research (1963), on the sensitivity to initial conditions. They thus described the processes that are known to have a non-integer order of integration using Hurst's research. The development of time series econometrics comes from Mandelbrot's studies (1971, 1972). The series order of integration can be fractional, which presupposes the presence of long term behaviour in series which cannot be apprehended by standard linear models. This behaviour is moreover contrary to the normal distribution hypothesis. In his research on a number of financial markets, Mignon (1996) showed the non-integer nature of the order of integrations in parallel to the non-normality of distributions. Applying tools from models of deterministic chaos with Lyapunov's exponents, the correlation dimension and Hurst's exponents show the existence of a structure of deterministic chaos. Walter (2001) presented a *"working paper"* on the statistical distributions of stock market fluctuations. The author perfectly described the non-gaussian nature of market returns and brought to light the use of alpha stable distributions of a non-linear nature. And lastly Monino and Matouk (2005) use entropy to determine Lyapunov's exponents through data boxes. They confirmed that returns do not follow a normal distribution and that they cannot be modelled by means of nonlinear deterministic chaotic processes.

The econometric evolution has led to more rigorous results from memory tests. It however never gave any pertinent justification for challenging efficiency. On the contrary, the improvement of methods confirmed the market efficiency hypothesis.

Moreover, a more complex problem arises from the analysis of financial series that is why use models based on a representation of the *i.i.d.* sort when it absolutely does not account for the phenomenon under study. This is a major obstacle for the theory of efficiency. Indeed, this theory is defined as belonging to the normal random-walk theory, except that the processes do not follow such a law. The model seems to be biased from the onset, which explains why the results found were not convincing. This leads us to express some doubts with regard to the efficiency hypothesis. For Fama (1970), however, the important point is not so much the normal distribution, but the inability to have access to past returns for previsional purposes with a view to make profits, that is to say implementing a model which performs like the random-walk model. In fact, non-normality, despite it being a source of inefficiency, alone cannot challenge the market efficiency hypothesis.

Seasonal Effects

The existence of temporal or calendar anomalies contradicts the market efficiency hypothesis. The presence of these seasonal effects suggests certain market inefficiency. Investors should be able to get profits through trading strategies. The day of the week effect is documented by average returns. The model estimates returns for a week day by a standard regression where dummy variables are introduced. The econometric model is known as the DVA model[9]. This model is explained through the very clear explanations given by Miralles and Miralles (2000). The process is called the DVA model. That is: $r_{i,t} = \beta_1 D_{1,t} + \beta_2 D_{2,t} + \beta_3 D_{3,t} + \beta_4 D_{4,t} + \beta_5 D_{5,t} + \varepsilon_t$, where $r_{i,t}$ represents the daily asset return; D_{jt} dummy variables are given the value 1 if returns correspond to t Monday, Tuesday, Wednesday, Thursday, Friday and the value 0 otherwise. Coefficients β_j represent the average return for weekdays; ε_t an error term. The model tests the null hypothesis according to which average returns are equal for different days. If it is rejected, it implies that the weekday effect is present. It allows the forecasting of price variations on some days and to make profits. Rejecting the null hypothesis means that the weekday effect is present. Furthermore, it allows the anticipation of price variations on some days and to obtain profits. The first research on the topic showed the existence of significant seasonal effects. French (1980), Gibbons and Hess (1981), Prince (1982), Rogalski (1984) and Smirlock and Starks (1986), Hamon and Jacquillat (1991) have shown that returns on Mondays are negative, as compared to other days in the week. Similarly, Jaffe and Westerfield (1985) as well as Smirlock and Starks (1986) with regard to American and Canadian markets, point out the week-end effect, that is to say returns on Fridays that are greater than that of other week days.

This first econometric model, however, is hampered with two major problems which bias results. It is possible that, residuals are auto-correlated and that the residual variance be not constant over time. Taking into account residual autocorre-

lation in the regression model is solved with the introduction of returns with a one day adjustment lag. Berument and Kiymaz (2001) thus defined the following model:

$$r_{i,t} = \beta_1 D_{1,t} + \beta_2 D_{2,t} + \beta_3 D_{3,t} + \beta_4 D_{4,t} + \beta_5 D_{5,t} + \sum_{j=1}^{4} \beta_{j+5} . r_{t-j} + \varepsilon_t .$$

Empirical results lead to different conclusions. Gardeazabal aand Regulez (2002) studies the Spanish market from January 1998 to December 2000. They could not show evidence of daily seasonal effects. Apolinario, Santana, Sales, and Caro (2006) examined markets from 13 European[10] countries. The results show that the day effect is not evidence in most European markets. It appears that the first results showing the presence of the day effect was due to auto-correlation.

The integration of variance variability is introduced using the ARCH model. Conditional variance (σ_t^2) changes over time as a linear function of past squared errors. Berument and Kiymaz (2001) included dummy variables in the GARCH model, which takes into account possible stationary effects within the equation of variance. Consequently, joint estimations of weekday's effects are obtained not only on averages but also on conditional variances, thus:

$$r_{i,t} = \beta_1 D_{1,t} + \beta_2 D_{2,t} + \beta_3 D_{3,t} + \beta_4 D_{4,t} + \beta_5 D_{5,t} + \sum_{j=1}^{4} \beta_{j+5} . r_{t-j} + \varepsilon_t$$

$$\varepsilon_t \sim i.i.d\ (0, \sigma_t^2)$$

$$\sigma_t^2 = \alpha_1 D_{1,t} + \alpha_2 D_{2,t} + \alpha_3 D_{3,t} + \alpha_4 D_{4,t} + \alpha_5 D_{5,t} + \sum_{i=1}^{q} \alpha_5 + i \cdot \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \gamma_i \sigma_{t-i}^2$$

Empirical results with the integration of the GARCH effect showed the interest transfers from the returns to volatility. Berument and Kiymaz (2001) showed a weekend effect with regard to volatility, for the SP500 from January 1973 to October 1997. Berument and Kiymaz (2003) studied a number of international financial markets[11]. They found that high volatility occurs on Mondays for Germany and Japan, on Fridays for Canada and the United States and on Thursdays for the United Kingdom. Returns, however, were not significant for the markets under study. Apolinario et *al*. (2006) detected abnormal and significant volatilities which vary according to the days and countries concerned. With respect to returns, they are no longer significant. Integrating auto-correlation and variance variability in the model showed slight returns significance in favour of studies in volatility. The evolution of the econometric model modified the conclusions. Once again, by taking bias into account, such as autocorrelation and heteroscedasticity, this reveals erroneous results. Considering these well-known phenomena in econometric has led to the disappearance of significant daily effects on returns. This confirms the progression of financial markets efficiency according to Fama.

Trading Volumes

Studies in financial markets have shown that endogenous information is not only limited to series of asset returns. The volume is an informative endogenous variable of

financial markets. Karpoff (1987), in a review on the literature, quoted the old saying in Wall Street *« It takes volume to make prices move »*. The volume in exchanged was widely used to examine its capacity to predict future price evolutions. It is in direct link with the market, since price variations in shares are represented into the bid ask imbalance. Two types of relationships were developed.

The first analysis can be found in Clark (1973) who developed contemporary relationships (later improved by Epps and Epps, 1976; Tauchen and Pitts, 1983). The authors showed that returns and trading volumes are driven by the same latent information arrival. The trading volume is used like a proxy variable [12] for the rate of information flows. The author finds a positive relationship between change variations in prices and trading volumes. If the information is uncertain, then price changes will coincide with high volumes (and inversely). The positive relationship between price change variations and the volume was verified by Harris (1983) for individual shares; Chow, Hsiao and Liu (2001) for the market in Taiwan; Jain and Joh (1988), Wu and Xu (2000) for the NYSE; …. Nevertheless, no indication was given as to the potentialities of predicting stock prices using trading volume. Contemporary relationships only show the link between price variation and volume. The second relation, known as contemporary, improves specificity and the first results on the analysis of trading volumes. It examines the possibility of a causal relationship between them and prices. If such a relationship is found, it is clear indication of inefficiency. It is possible to predict future evolutions in share prices. Jain and Joh (1988) use a causality test to identify the presence of a sequential relationship between returns and volumes, later extended to an autoregressive model. They use the equation for the standardized volume as a function of the contemporary relationship for returns according to the following regression: $PVOL_t = a + \sum_{n=-4}^{4} b_n \left|PRET_{t-n}\right| + \sum_{n=-4}^{4} c_n \left(\left|PRET_{t-n}\right| - DUM_{t-n}\right) + v_t$.

Where $PVOL_t$ is the volume of standardized exchange at time *t*, $PRET_{t-n}$ represents the standardized return at time *t-n*, DUM_{t-n} if returns at time *t-n* is positive, otherwise 1 ; v_t the random error terms, a, b_n, c_n on the parameters to be estimated. The first results for the model proposed by Jain and Joh (1988) show only little evidence of a causal relationship of volume on prices. The evolution in methodology to a bivariate autoregressive model has yielded more interesting results, based on a dynamic approach to the behaviour of variables. The empirical procedure was inspired by Granger's studies (1969) with regard to causality. If the prediction *y* using the past of *x* is more precise than the prediction without the use of the past *x* in the sense of the root mean square error, then *x* in the sense of Granger causes *y*. The following bivariate model is used to test causality between the variables in the trading volume, asset returns and volatility:

$$\begin{cases} x_t = \alpha_0 + \sum_{j=1}^{m} \alpha_j x_{t-j} + \sum_{i=1}^{n} \beta_i y_{t-i} + \varepsilon_t \\ y_t = \gamma_0 + \sum_{i=1}^{m} \gamma_i x_{t-i} + \sum_{j=1}^{n} \delta_j y_{t-j} + \eta_t \end{cases}$$

Where, x_t and y_t are the trading volumes and returns respectively; α_0 and γ_0 are constants; ε_t, η_t of error terms. If the coefficients β_i are statistically significant, then the inclusion of past values in returns and volumes leads to better prevision of future volume. Thus, returns cause volumes. If a test-*F* does not reject the null hypothesis that β_i=0 (for any *i*), then returns do not cause volumes. Such is the same for the second equation.

Empirical results are identical to those found in the case of returns. Indeed, Chordia et Swaminathan (2000) studied the American market and noted that it is not evident that investors could obtain profits due to transaction costs. These results are identical for Lee and Rui (2002) for such market indexes as the United States, United Kingdom and Japan. Pisedtasalasai and Gunasekarage (2005) studied different countries[13] and, they did not showed any significant link of volume causality towards prices. There is no possibility of using volumes of exchange to forecast returns. The volume of exchange is therefore not an endogenous informative variable of good quality for the purpose of predicting returns.

Generally, the econometric evolution of models pertaining to endogenous information brings clear conclusions. Taking into account known econometric problems, such as auto-correlation and heteroscedasticity in models, strengthens the likelihood of challenging markets efficiency. Indeed, these results can be found in all identified results (variance ratio tests, long memory tests, seasonal bias, trading volumes). The robustness of models provides a clear indication on a shared conclusion in the analysis of exogenous information. Moreover, the problem related to models specifications based on a representation of the *i.i.d.* sort, which just do not at all take into account the phenomena under study, remains an element of doubt on these very models. Indeed, we recall that the model seems biased from the onset, which is probably a decisive element with regard to the results shown on the analysis of endogenous information. Consequently, this type of information is not pertinent for predicting price evolutions and challenging the efficiency hypothesis. All analyses of these types of information do not highlight any tangible result on the likelihood of beating the market. This synthesis of the main tests, as well as endogenous information results, confirms the observations made by Brian and Walter (2008) on the bad quality of this type of information in the analysis of financial markets. It does seem that the market is efficient in the sense of endogenous information.

Efficiency with Endogenous Information

Information said to be *'exogenous'* originates from components outside of the market, which generally affects a firm then the whole market. The elements of which it is composed arise from the fundamentals of the economy and financial and economic information. It is publicly available information that is wide in scope, of a complex and distributed nature because it needs to be analysed before it is interpreted. The origins of information sources in the different analyses vouch for the search for reliable information, which is at the core of any process of economic intelligence. The analysis consists in verifying if the use of this data makes it possible to test the efficiency hypothesis by observing the likelihood of anticipating variations and make profits.

Since the 70's, the empirical literature on exogenous information has barely evolved. We make a distinction between two main efficiency tests through this informational type.

The first is concerned with typical events in listed firms. The efficiency hypothesis was verified for a great number of specific announcement effects well known in the literature (stock splits, earnings results, recommendations …), which are called *'event studies'*. Exogenous information is endowed with an informative content which indicates the desired influence of information on asset prices, taking the market consensus into account. It was defined under the concept of good and bad news by Ball and Brown (1968). The econometric methodology used has remained the same ever since Fama et *al*. (1969). It is based on a specific type of event for a great number of firms.

The second one is an important widening of the overall exogenous information used. These recent research studies focus on the informational impact on stock prices. The model developed no longer investigates a specific event but media flows. It is now possible to determine the informational impact of a data set, defined under the name of informative coloration. This signifies the development of Ball and Brown's (1968) concepts of good and bad news into an informative flux. The econometric method is a new approach implemented by an original econometric model which thus relies upon a non-parametric model taking into account all exogenous information and links them to compare them with stock returns.

The overview of results from these research studies which investigate efficiency through exogenous information points to a common conclusion. It is completely opposite to that of endogenous information.

The Sources of Information under Study

The choice of the source of information dissemination is essential to the study of exogenous information. Exogenous information is published through a distribution channel called the media. According to Pateyron (1998), Bloch (1999), Martinet and Marti

(2001), the concepts of business intelligence indicate that these data must be recent and pertinent. In addition, Martinet and Marti (2001) insist on the use of substantiated information sources. These various findings point out that media information from the written press best correspond to these criteria. Information are true and of good quality.

From the 1970's, the literature on efficiency according exogenous information uses data from the media. Indeed, Lloyd-Davies and Canes (1978); Liu, Smith and Syed (1990); Chang and Suk (1998); Ferreira and Smith (1999, 2003) … studied the columns of the *'Wall Street Journal'*. In the context of international markets, we took note of the *'Hong Kong Economic Journal'* by Chan et Fong, 1996; etc. ; publications from the *'German Personal Finance Magazines'* for the German market by Kerl and Walter, 2005, 2007 ; etc. And on the French market, we observed *'Les Echos'*, *'La Tribune' and 'Le Figaro'*, Lardic and Mignon (2002, 2003).

Efficiency with Endogenous Information

Event Studies

The Concepts of Good and Bad News

Exogenous information has an informative content which indicates the expected influence of information on asset prices, taking the market consensus into account. The contents are broad and evoke market expectations in the light of exogenous information as well as the (national and international) economic and financial climate and sector-based (competition, monopoly, leader), etc. Studies from the literature have used this principle to provide a forecasting on the future evolution returns. Ball and Brown, (1968) have respectively identified two interpretations:

- The *good news*.
- The *bad news*.

The good (bad) news corresponds to an information from which we expect a rise (or drop) of stock prices, taking into account the market consensus. Boya and Monino (2010) have reviewed the literature on good and bad news in the study of efficiency. We have noted that, respectively, recommendations for purchase (sale), announcements for results higher (lower) than previsions, mergers, marketing partnerships, new customer acquisitions, management changes in large (small) capitalizations are considered to be good (bad) news. Empirical research has used this principle for all announcements effects of firms.

Events Modeling

Events' modeling is the first tool which measures the influence of exogenous information on stock prices. It uses information release to examine the presence of

significantly abnormal returns. The *'events modeling methodology'*[14] is based on the market model, as defined by Fama et *al*. (1969). The authors describe it as follows $AR_{j,t} = R_{j,t} - \left(\hat{\alpha}_j + \hat{\beta}_j R_{m,t}\right)$. With $AR_{j,t}$ the abnormal return for the *j* value as on day *t*. Where $R_{j,t}$ is the return for the value *j* as on day *t*, $R_{m,t}$ is the market returns as on day *t*, and $\hat{\alpha}, \hat{\beta}$ are two parameters estimated by means of the ordinary least squares approach for the firm *j*. Liu et *al*. (1990) revealed the average abnormal return for a sample of *N* values, with: $\overline{AR_t} = \frac{1}{N}\sum_{j=1}^{N} AR_{jt}$, $t = -10,...,+10$. In order to test the significance of $\overline{AR}$, the authors calculated the standardized abnormal return for the value *j* as on day *t*, with $SAR_{jt} = AR_{jt}.S_j$. S_j is the residual standard deviation for the value *j* estimated from the regression of market model. The standardized average abnormal return is given by, $\overline{SAR_t} = \frac{1}{N}\sum_{j=1}^{N} SAR_{jt}$. Let us assume that abnormal returns, $AR_{j,t}$, are identical and independently distributed with finite variance, then statistical tests for a sample of *N* values don a day *t*, *T (t, t)* and statistical tests on the period *T1* to *T2*, *T (T1, T2)* are distributed according to the Student law in the absence of abnormal performances such as $T\left(t,t\right) = \overline{SAR_t}.\left(N\right)^{1/2}$.

Nowadays, this methodology is still widely used and it has not at all evolved since its creation. It consists in observing the impact of an announcement effect specific to a set of firms for a period given on the day of information release. Ball and Brown (1968), for instance, studied earning results 261 American firms. Fama et al. (1969) have a sample of 940 firms for the observation of stock split. Pattel and Wolfson (1984) studied 571 earnings results for a sample of 96 firms, etc. The aim is to highlight the existence of abnormal returns, which are evidence for market inefficiency. The latter shows the presence of a deviation between an actual stock price and its theoretical price. Furthermore, it brings to light the informational impact of an announcement. It is possible to use the exogenous information to make an exceptional gain. A forecasting of returns at the time of a specific event will thus depend of the amount of an abnormal return obtained from the study of a previous announcement. Stock price forecasting can be spread around the day of its release.

Ball and Brown (1968) noticed that when firms' announcements of earning results are greater than previsions, their stock prices increase. They demonstrate the existence of abnormal returns as a source of inefficiency. These results were confirmed by Pattel and Wolfson (1984), and Benos and Rockinger (2000) on capitalisations from the SBF 120. The information was not correctly anticipated by the market, which signifies a certain source of inefficiency.

Lamoureux and Poon (1987) examined stock split. They pointed out that the abnormal return is significant the day before an announcement and the following two

days. Dowen (1990) confirms the informational impact of the division on the NYSE and the existence of abnormal returns. In particular, they observed that the adjustment lag between an information release and the intrinsic value of stock prices is not immediate. Such a lag presupposes a potential for profitable trading techniques. These results are confirmed by Masse, Hanrahan and Kushner (1997) for Canadian and Greek markets, as well as by Gómez-Sala (2000) and Menéndez and Gómez-Anson (2003) for the Spanish market.

Lloyd-Davies and Canes (1978), investigated the *'Wall Street Journal'* columns. They stated that these recommendations provide significant abnormal returns on the day of publication but also within a two-day interval[15]. Liu et *al*. (1990) as well as Ferreira and Smith (1999, 2003) also with regard recommendations from the *'Wall Street Journal'* confirm these results. Information contained in the *'Wall Street Journal'* has an informative content which makes it possible to forecast stock prices variations but also to make exceptional gains. Researches on international markets showed the same conclusion. Lidén (2004) studies the Swedish market, and Kerl and Walter (2005, 2007) the German market. They note that sales recommendations can potentially yield a certain gain greater than the market. The authors show that the abnormal positive returns for purchase recommendations spread from t - 7 to t + 2 . These results are statistically significant and can generate gains.

More recently, other announcement effects were examined with similar conclusions. Announcements about mergers and acquisitions (Husson, 1987 ; Lardic and Mignon, 2002, 2003 ; etc.) ; events concerning marketing and distribution partnerships ((Koh and Venkatraman, 1991 ; Schakenraad and Hagedoorn, 1994 ; Evraert, 2007), New customer acquisitions (Amit and Zott, 2001 ; Fernandez, Callen and Gadea, 2005 ; etc.) ; management changes in large capitalizations and recent firms (Rajgopal, Kotha and Venkatachalam, 2002 ; Lardic et Mignon, 2002, 2003 ; Evraert, 2007), have all shown significant abnnormal returns around publication days and around. They indicate the potential for making profits from using this exogenous information.

The literature concerning the analysis of exogenous information on the basis of specific announcements challenges the efficiency hypothesis. Indeed, they show significant abnormal returns, thus confirming that it is possible to make exceptional profits. Furthermore, it is possible to forecast future evolutions in stock prices thanks to the coloration of information, which indicates if the expected event is either positive or negative which respectively leads to an upward or downward evolution of stock prices. The first result shows that the exogenous information is adequate enough to forecast stock prices and make gains. It is an efficient decision making tool. Orléan (1989), Walter and Brian (2008) stipulate that a financial market is defined by its capacity to convert information into price. These first conclusions show that exogenous information is pertinent in relation to the value of securities, which confirms analyses made by Brian and Walter (2008). Endogenous information can be used for the pur-

poses of building on a firm's value. Its study is a tool for the purpose of decision making, so as to forecast stock market evolutions and question the efficiency hypothesis.

The Analysis of an Informational Flux

The '*event studies'* methodology is a pertinent tool to test efficiency from exogenous information. When specific events are published, it enables the prediction of stock returns. Past knowledge of informational impact on returns will allow agents to anticipate future announcements. It is evident that these analyses probably omit pertinent exogenous information which are likely to influence significant price changes and to more efficiently test the efficiency hypothesis.

The Information Coloration

The *'events studies'* designation arised from the fact that these analyses are solely concerned with some announcements specific to firms (earning results …). The potential for analyzing exogenous information is limited to firms' usual events. The scope of the study remains extremely reduced. From this characteristic, analysts can avoid to consider the documented contents so as to identify the eventual impact of information on returns (either positive, negative or neutral). *'Event studies'* use a qualitative strategy to examine information. This is limited to events which can easily be interpreted. It becomes impractical for the analysis of important and pertinent exogenous information.

In light of these restrictions, a method for the interpretation of information has been developed. Boya (2008, 2009) as well as Boya and Monino (2010, 2011) have indicated that the differentiation between good or bad news, thus classified as a function of its influence on returns, has been considered without, however, being translated into a model. The authors therefore introduced, defined and developed a model and generalized the impact of an exogenous information to all information in the media in order to test the efficiency hypothesis in the light of exogenous information. Let a set *A* consisting in ordered elements (exogenous data) concerning a set *F* from a population *P* « *at a time t* ». Let Ω the non-ordered set of all *A* sets, such as Ω containing *A* so that $A \cup \overline{A} = \Omega$, with *A=A1, ...,Ak*, such as $A = \left\{ \bigcup_{k=1}^{n} A_k \right\}$.

The authors considered the element i_l (news), *l=1,...,n* as belonging to the set made of two sub-sets I^+ and I^- with $I^+ \cup I^- = I$. They classified the elements respectively: i_l^+ as an element associated to good news, such as $i_l^+ \in I^+$ (with I^+ representing the good news as a whole) to which a number is associated, such as *il+=1*, and i_l^- an element associated with the bad news, such as $i_l^- \in I^-$ (I^- that being of the bad news) to which is associated a number such as *il-=-1*. Thus, when *l* varies as *l=1,...,n*, the au-

thors have the sum of the good and bad news. A matrix (*n, m*) such as *C=cl,k*, where *cl,k* indicate the values for the news *l* (news) given in each element *k*.

The concepts override the notion of good and bad news, because they can be applied to all the exogenous data and not solely on shared elements (earning results, recommendations …). The method of analysis is based on discourse analysis using statistical techniques applied to textual segmentation. To this effect, the authors translated the information into a model in a matrix form. To each news is associated its quality (good or bad). Lin et Hovy (1997, 1999) have shown that the impact of a news is a decreasing function of its rank. They introduced a weighting value based on data segmentation. The authors introduced a weighting value α, a decreasing function of the rank, such as $\alpha l = rank\ il\text{-}1 rank\ il$, where *rang il-1* represents the rank classified in decreasing order, with $\alpha\alpha \in \mathbb{R}$, $\alpha < \alpha < \alpha$ et $l = 1n\alpha l = 1$. Thus, it is possible to define a matrix (*n, m*) such as $D = \left[\alpha_{l,k}\right]$ where $\alpha\left(l,k\right)$ represents the weighting values of the news *l* found in each element *k*.

The coloration of information is given by a matrix product. It shows mathematical properties. Since the matrix *C* and *A* are of the same type, we are faced with a Hadamard product. Thus, $C * D = B$ such as $cn,m\ .an,m = bn,m$. The weighted sum of each matrix column *B* gives a scalar coloration of each A_k. Thus the authors provide the coloration of information.

The hypothetical impact of an event on stock exchange returns is a function of its informational nature, taking the market consensus into account, defined under the concept of coloration of endogenous information. The coloration of information is defined under three distinctive cases:

i. Positive coloration: this represents an exogenous information for which we anticipate a positive impact on stock prices,
ii. Negative coloration: this represents an exogenous information for which we anticipate a negative impact on stock prices,
iii. The null coloration: it represents exogenous information exogenous nullifies itself. In this case, it is impossible to anticipate the evolution of the asset.

The study of media flux

The latest researches by Boya and Monino (2010, 2011) have broadened the analysis to a set of exogenous information for each firm listed on the market and no longer on a type of event for a number of firms as was the case for event studies. The authors' field surpasses previous studies since it broadens the analysis to a flux of media information and no longer to a few specific announcements. Nevertheless, the statistical analysis cannot be undertaken with the methodology given by Fama et *al*. (1969). Indeed, this methodology allows one to study a specific type of information, whereas we are dealing here with multiple exogenous information. The authors developed

a non-parametric model to analyze succeeding information between the qualitative fluctuation of stock exchange shares and the coloration of exogenous information for each day. This model has qualitative properties with two possible outcomes 0 and 1, in accordance with Markov's chains. In order to confirm the existence of a relationship between the series, the authors defined a confidence interval by the Bootstrap.

It is thus possible to analyze exogenous information never tested beforehand. These research studies examine information from the media on three informative French corpus ('les Echos', 'the Tribune', 'the Figaro') and classify events as a function of three informative groups 'Result', 'Stock exchange', 'Activity'. The authors' results indicate the presence of an informational impact statistically significant for all corpus studied, for informative groups as well. Consequently, the model makes match the coloration of exogenous information to stock markets fluctuations. Furthermore, the authors have found that the informational impact is also significant the day before information release in the case of all the groups analyzed. This indicates that the lifetime of information on share prices is longer than was previously described by efficiency. These results clearly show that the analysis of exogenous information makers it possible to anticipate the evolution of stock prices. It is therefore a pertinent tool for the decision making process.

Moreover, Boya (2008, 2009) developed a method to analyze returns in the context of exogenous informative flux from the market model for event studies. In this model, the author calculates the abnormal returns taking into account the informational flux and by introducing a sampling variable which corresponds to the sum of returns obtained when information strikes the market. The model measures the existence of an impact from media information on stock exchange returns. It is based on research by Fama et al. (1969) applied for the entire exogenous information concerning a specific firm. Evidence from abnormal returns is highlighted by the well-known model from research on the semi-strong form of efficiency. Let $\tilde{r}_{f,t}$ be the returns from firm f at time t, being linear function of returns from the market $\tilde{r}_{cac,t}$ such as: $\tilde{r}_{f,t} = \alpha + \beta.\tilde{r}_{cac,t} + \tilde{\varepsilon}_t$, with α a constant and β the coefficient estimated from the ordinary least squares relationship, and where $\tilde{\varepsilon}_t$ represents the abnormal return from the firm we shall denote. $AR_{f,t}$. The abnormal return, with information taken into account, is expressed as follows: $\sum_{t=1}^{t=261}\left(AR_{f,t} \middle| y_i = \begin{cases} 1 \\ -1 \end{cases} \right)$. It corresponds to the sum of the returns obtained when information strikes the market. The coefficient θ indicates the mean for abnormal returns with regard the information: $\theta = \left\{ \frac{1}{T'} \left[\sum_{t=1}^{t=261} \left(AR_{f,t} \middle| y_i = \begin{cases} 1 \\ -1 \end{cases} \right) \right] \right\}$. With T' representing the number of times information strikes the market. We carry out a bilateral hypothesis test. This type of test aims at the Student law such as: *t.Student* ~ $\alpha 2$*; T'-1 degree of liberty.*

The author shows significant abnormal returns as on the days of information release. These results are confirmed for two examined corpus of exogenous informational flux. The exogenous information have therefore significantly statistical impacts on stock prices. The market reveals pockets of inefficiency on the days of information release. The use of an exogenous information flux makes it possible to test the efficiency hypothesis and to challenge it. It emphasizes the possibility of beating the market and makes exceptional profits. Consequently, the analysis of this type of information is pertinent. All the parameters needed to challenge the efficiency hypothesis are present.

The analysis of exogenous information generally shows tests with unequivocal results. Both models on this type of information show that in all cases they challenge the efficiency hypothesis. The econometric model of specific announcement effects has a rather long lifetime. It has only been since the end of the years 2000 that the authors have attempted a new approach which arose from the possibility of taking into account an informational flux. The exogenous information is thus examined as a whole and can be interpreted globally which was not the case with early research limited to firms' announcements easy to interpret. This major evolution has also lead to a new original econometric model based on non-parametric properties. The results from exogenous information tests support arguments by Brian and Walter (2008) on the good quality of this type of information to test financial markets. The market is inefficient in the sense of exogenous information.

Conclusion

The definition of efficiency proposed by Fama was divided into two forms: weak, semi-strong and strong. Nevertheless, a new classification was introduced which examined financial market through this type of information. We made observations on two types: endogenous information and exogenous information. This new framework of analysis is of a wide range. It allows the classification of information according to its origin inside or outside of the market. Thus, there is on the one hand quantitative data such as price, volume history and volatility representing endogenous information. On the other, we find qualitative data which need to be studied, analyzed which originate from media sources among others, and which are the product of exogenous information. The value of this classification is to show that these two types of complementary information bring out conclusions that are interesting from their empirical and entirely antagonistic points of view.

The efficiency approach, through the concept of endogenous information gathers into the same approach tests of the weak form (variance ratio tests, long memory), price fluctuations with regard seasonal bias as well as trading volumes. These are all data of a quantitative nature. All analyses point to identical results. It is impossible to

challenge the market efficiency hypothesis. Indeed, even if some conclusions reveal the presence of long memory or of imperfections in the random walk, it is not possible to forecast with any precision future variations in stock prices. The econometric improvements of the models used, whilst talking into account well known problems such as heteroscedasticity and autocorrelation, all test and support efficiency. Not one study based on an econometric model can challenge market efficiency. Lastly, the normal distribution specificity, which does not take into account the phenomena under study, still remains a major inconvenient on account of models which thus appear biased. It does seem, therefore, that endogenous information is of small value when challenging the actual efficiency hypothesis. This overview of the literature on endogenous information confirms criticisms by Brian and Walter (2008) on the bad quality of this type of information and its inability to inform on building future prices (Orléan 1989).

The concept of exogenous information is concerned with research on the semi strong form, otherwise called event studies, as well as media flux according to a different econometric method. These data originate from outside the market. The analysis of the literature shows several differences between endogenous and exogenous information. Contrary to endogenous information, it contains data of a qualitative nature which must be interpreted before being used, then inserted again into a quantitative study. We have seen that these data mainly come from media sources whether in the context of usual event studies or of informational flux. But the results are greatly in opposition. Indeed, the analyses of exogenous information show that they are of good enough quality to challenge the current market efficiency hypothesis. They first of all allow the anticipation of return variations on a two day spectrum. This is a first sign of inefficiency. They then reveal abnormal returns, showing the possibility of beating the market. Lastly, recent developments have shown that it is possible to provide a method to analyze a large number of exogenous information and no longer of only a few specific announcement effects. These research studies are corroborated by the emergence of profitable returns thanks to the presence of non-normal returns.

From this overview of the literature, it appears that exogenous information is of good enough quality to challenge the efficiency hypothesis and anticipate stock exchange variations. This confirms the first conclusions made by Orléan (1989), Matouk and Monino (2005), Walter and Brian (2008), Boya (2008, 2009) as well as Boya and Monino (2010, 2011) on the importance of analyzing exogenous information which are pertinent to creating price value. Moreover, the possibility of analyzing large numbers of exogenous information through statistical models brings to the fore, more than ever before, the advantages of using this type of information for agents' decision making process on anticipation. It becomes possible to transform qualitative information into a quantitative scalar product and thus compare price fluctuations in an efficient and robust manner.

The differences encountered in the results according to the type of information analyses must enable us to question future research. Why are these results so different between two types of information?

Endogenous information is based on quantitative data which arise from highly specialized and robust econometric models, as we have seen in well documented inherent problems. These leave no room for human judgment. The results may be considered as true. However, an *i.i.d* representation on linear models used remains a parameter which, not well understood, biases results. The use of better adapted models which better reveal leptokurtic phenomena thanks to nonlinear deterministic chaos models is still very rare. This is probably due to the difficulty in controlling these nonlinear models sensitive to initial conditions. Without an application which, through these models, takes into account these aspects in future research, the market will appear efficient through endogenous information.

On the contrary, exogenous information is based on data to be analyzed. These are data of a qualitative nature. Their interpretation depends on human knowledge. Thus, agents anticipate stock prices from exogenous information, knowing that all other agents will interpret the information in the same way, thus probably influencing self-fulfilling anticipations on stock prices evolutions. This phenomenon could create pockets of inefficiency inside the market. This mimesis is being studied by behavioral finance. Results have shown that exogenous information was of a pertinent quality in the analysis of financial markets. Consequently, future research could work on the analysis of exogenous information, where human judgment interferes, alongside analysis in behavioral finance, studying mimesis phenomena and self-fulfilling anticipations. Such future research could be a way of better apprehending the challenging of efficiency by analyzing concomitantly these studies and results.

NOTES

[1] for Walliser (2000) indirect information,

[2] defined by Walliser (2000) under the expression direct information.

[3] Canada, Austria, Finland, France, Germany, India, Italy, Japan, New Zealand, Norway, South Africa, Sweden, Switzerland, Great Britain, United States of America.

[4] Argentina, Brazil, Chile, Mexico.

[5] United States: Dow Jones; Japan: Nikkei; Germany: Commerz Bank Index; Great Britain: FTI; Hong Kong: Hang Seng Index; Taiwan: Weighted Index; South Korea: Composite Index; Singapore: Straits Times Index; Australia: All Ordinaries Index.

[6] From January 1965 to December 1990.

[7] From 1962 to 1995.

[8] The SP500 for the United States, the FT 500 for Great Britain , the SBF 250 for France, the TOPIX for Japan, the TSE 300 for Canada, the FAZ for Germany and the BCI for Italy

[9] The Dummy Variables Approach

[10] Germany, Austria, Belgium, Denmark, Spain, France, the Netherlands, Italy, Portugal, the United Kingdom, the Czech Republic, Sweden and Switzerland.

[11] The TSE for Canada, the DAX for Germany, the FT-100 for the United Kingdom, the NYSE for the United States, Nikkei for Japan, from January 1988 to June 2002.

[12] A proxy variable signifies a variable that is used in place of another.

[13] Indonesia, Malaysia, the Philippines, Singapore, Thailand, United States, England, Japan.

[14] Event Study Methodology; Event Time Methodology; CAR method (cumulative abnormal return method).

[15] These results are consistent with those of Pattel and Wolfson (1984); Collins and Kothary (1989).

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