Assistant Professor Sorin DUMITRESCU, PhD
E-mail: sorin.dumitrescu@rei.ase.ro
Master Student Alexandra STROE
Professor Alexandra HOROBET, PhD
Associate Professor Radu LUPU, PhD
The Bucharest Academy of Economic Studies

MARKET EFFICIENCY IN AUSTRIA AND POLAND: A COMPARATIVE EVENT STUDY ANALYSIS[1]

Abstract. *This paper adopts a behavioral finance framework for a discussion about efficiency in developed versus emerging capital markets. We show that the developed Austrian capital market appears more efficient than the Polish capital market by conducting an event study of earnings announcements of companies listed on these two markets. We show that for the Polish market one cannot reject the hypothesis that information about earnings surprises is gradually incorporated into price, while on the Austrian market earnings surprises seem not to affect cumulated abnormal returns, which leads to the conclusion that this market is efficient.*
Keywords*: market efficiency, capital markets, event study, Europe.*

JEL Classification: G10, G14

1. Introduction

The field of behavioral finance has emerged as an alternative to the traditional approach to modeling financial phenomena, which contends that investors who are rational dominate those who are not, such that arbitrage opportunities are quickly eliminated. Behavioral finance, through its "open-minded" approach, gains an extraordinary explanatory power which proves extremely useful in situations where traditional finance fails to predict correctly market interactions and investors' decisions. In the first part of the paper, we discuss the evidence against market efficiency, and especially the arguments from behavioral finance. In the second part, we conduct an efficiency test of two different securities markets, in order to obtain a comparative analysis of the developed Austrian capital market and the emerging Polish market. The premise from which we start the analysis is that emerging markets tend to be inefficient, while developed markets are efficient. We make no

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claim that the informational inefficiency of emerging markets can be systematically exploited, because profit opportunities may disappear in the presence of market frictions.

1.1. The behavioral finance framework

The assumption that all people have rational beliefs and make rational decisions is a well known idealization in economics, lying at the foundation of economic theories and perceived as an approximation of reality, made with the hope that departures from rationality will disappear under the discipline of the market (Kahneman, 2003). Nevertheless, this is not always the case and as a consequence behavioral studies emerge as a complementary field alongside economics and finance in particular. Behavioral finance, – the study of human fallibility in competitive markets (Shleifer, 2000) has grown therefore from the inability of the traditional framework to explain various empirical patterns. Thaler (1993) sees behavioral finance as being simply "open-minded finance" and argues that sometimes, in order to find the solution to an empirical puzzle, it is necessary to consider the possibility that there might be some economic agents that do not behave fully rationally on some occasions. Behavioral finance, as a sub-discipline of behavioral economics is therefore a relatively new field of study, incorporating findings from psychology and sociology into its theories, and constructed around two major theoretical foundations: investor sentiment or cognitive psychology (the theory of how real-world investors actually form their beliefs, valuations and their demands for securities) and the theory of limited arbitrage which is one of the most solid arguments for the inefficiency of markets Ritter (2003).

To understand the research agenda, methodology and contribution of various theoreticians, it is mandatory to review the traditional finance theory first, particularly the building block of behavioral finance, the Efficient Market Hypothesis (EMH). The key point of interest would be to see whether investors' irrationalities affect market efficiency because even if market participants are irrational, it may be possible that the market would gradually absorb or find correspondences to individuals' irrationalities and thus prevent their impact on market prices.

1.2. The efficient market hypothesis

The EMH was perceived as the central proposition of finance for almost forty years and represents one of the most heated debates in finance history. Eugene Fama defined an efficient market as one where prices fully reflect all available information (Fama, 1970). The efficiency term associated with capital markets was afterwards revised to include also the fact that new information is immediately and correctly absorbed by stock prices in such a way that rational profit-maximizers, actively competing in the market and trying to predict future market values of individual securities cannot consistently beat the market (Fama, 1965). It is of obvious common-sense why such a hypothesis can by no means be received with enthusiasm by finance practitioners. The EMH has never been widely accepted on Wall Street and debate continues as to what degree analyzing securities performance can result in superior returns. EMH, by itself, is not a well posed and empirically refutable hypothesis. To make it operational, one must specify additional information and test the assumptions on which it lays it grounds. Therefore, a test of the EMH becomes a test of several auxiliary hypotheses such as the lack of transaction costs in the trading of securities, costless information available to all market participants, joint agreement between market participants on the implications of current information for current prices and distributions of future prices of each security. A market built upon these limiting assumptions is thought to be a market where the current price of a security fully reflects all available information.

Taking into account all the complexities of the real world in trying to validate the EMH is almost impossible. Nevertheless, while the before mentioned conditions are sufficient for market efficiency, they are not necessary. Transaction costs, a minority of investors that do not have ready access to available information or disagreement among investors do not necessarily result in the violation of the market efficiency hypothesis as long as the rest of the assumptions are respected.

1.3. Empirical foundations of the EMH

The mechanism of financial markets implies that as soon as there is a profit opportunity offered by the market in the form of new information on the under pricing of a security, investors will automatically react to bid up the price to a fair level. This stream of reasoning eventually results in concluding that prices increase or decrease only in response to new, relevant information and therefore new information is by definition unpredictable because otherwise it would have been already absorbed by stock prices. This is the essence of the argument that securities' prices follow a random walk.

The theoretical foundations of the EMH are constructed around three important arguments relying on progressively weaker assumptions (Grossman and Stiglitz, 1980). First of all, investors are assumed to be rational in valuing individual securities. Secondly, assuming that some of the investors are not rational, their random investing behavior cancels their trades and results in a zero sum game, having no influence on prices. Thirdly, assuming that investors are irrational and that their investing behavior does not result in the canceling of their trades, rational arbitrageurs will intervene to eliminate differences between the intrinsic value of stocks and their price. In what regards the empirical foundation of the EMH, Jensen (1978) was of the opinion that there is no other proposition in economics which has more solid empirical evidence supporting it than the EMH. These foundations can therefore be divided in two main categories (Shleifer, 2000). The first prediction of the hypothesis implies that new information in the market is instantaneously and correctly absorbed by individual securities while the second one states that securities do not react to non-information. While the immediate incorporation of the new information in securities' prices can be easily understood, a clarification is needed for the rest of the predictions. Correct adjustment implies that prices neither underreact nor overreact to specific news announcements and non-information refers to news that does not affect the fundamental value of the security.

With respect to the quick and accurate reaction of prices to new information, the principal hypothesis resulting from here, as identified by Fama (1970) points out that stale information is of no importance in obtaining superior returns after adjustment for risk. The complexity associated with quantifying the variable risk makes this statement very difficult to support or refute. In what regards stale information, Fama (1970) distinguishes between three different forms of stale information that consequently result in three different forms of the hypothesis. The "weak" form implies that stock prices reflect all information that can be derived from the examination of history of past prices, trading volume or short interest and therefore it is not possible to earn superior risk-adjusted profits based on trend analysis. The second version of the EMH is the "semi-strong" form stating that all publicly available information, namely data on the firm's product line, quality of management, balance sheet composition, earnings forecasts and accounting practices are already reflected in stock prices. The last version of the efficient market hypothesis and the most extreme and difficult to prove is the "strong" form version, stating that stock prices reflect all available information including the one that can be monopolistically accessed by corporate insiders or specialists. Early empirical tests conducted with the purpose of establishing the validity of the EMH have supported to a large extent the hypothesis particularly in its weak form. Fama (1965) proves that "technical trading strategies" cannot result in superior returns after adjustment for risk. Prices are as likely to rise as they are to fall after the previous day's evolution. Initial tests performed under the form of event studies, pioneered by Fama et al. (1969) corroborated the semi-strong form efficiency as well. In order to empirically test the second prediction of the EMH, Scholes (1972) evaluated share prices reactions to sales of large blocks of shares in individual companies and observed that such information does not exert a material impact on the stock price because this price is determined by the stock's value relative to that of its close substitute rather than by supply which is consistent with the theory that prices do not react to non-information.

1.4. Theoretical and empirical challenges of the EMH

The basic assumption in economics, the rationality of people in making decisions is at most a very controversial statement. Several times, investors react to not-so relevant information in forming their demand for securities. In many occasions, uncertainty about future demand and supply conditions within and across sectors determines investors to trade on noise rather than information (Fama, 1970). As a consequence, the complicated and vast investing strategies standing at investor's availability together with the cloud of information surrounding their trades result in a clear deviation from the traditional EMH. Kahneman and Riepe (1998) also contradict the first theoretical hypothesis on which EMH was established, by arguing that people deviate from the standard decision-making model in a number of fundamental areas. Beliefs based on heuristics rather than on simple rationality are sometimes called "investor sentiment" and most of the times result in judgment errors. If these judgment errors occur systematically they are called biases. A more thorough analysis of investors' biases will be performed when analyzing agents' rationality but a few important underlying aspects are still worth mentioning at this point. In studying these biases, Kahneman and Tversky (1979) observe that people tend to look not at levels of final wealth that they can attain, but rather at relative gains and losses as compared to a reference point. Moreover people also tend to exhibit loss aversion meaning that the loss function is steeper that the gains function, or in other words their dislike for losses outweighs their like for gains. A practical example of biases application in practice is represented by investors' aversion to holding stocks explained by the equity premium puzzle (Mehra and Prescott, 1985). The equity premium puzzle is based on the observation that in order to reconcile the much higher return on equity stocks compared to government bonds, individuals must have implausibly high risk aversion according to standard economics models.

The second argument on which the EMH stands is completely disposed of by several theoreticians who state that investors do not deviate from rationality randomly but rather they deviate in the same way. What is more, not only that trades in securities do not cancel each other out but it usually happens that investors tend to imitate each others' behaviors and actions and push prices even further away from the intrinsic value of the respective stocks (Shiller, 2003). The problem related to investors' deviation from rationality is further deepened by the intermediation process. Much of the money in financial markets is indirectly allocated with the help of financial intermediaries, such as pension and mutual funds (Lakonishok et al., 1992). Professional managers who are actually involved in the intermediation process are also in search of psychological comfort and as a consequence they may choose portfolios excessively close to the benchmark they are evaluated against, meaning that they select the same securities as other managers.

The third theoretical pillar of the hypothesis is strongly contradicted by the central argument of behavioral finance stating that, in contrast to the efficient market theory, real-world arbitrage is risky and therefore limited. The theoretical presumption of market efficiency based on arbitrage simply does not exist once the realities of real world arbitrage begin to be modeled. Limits such as lack of close substitutes for securities whose prices are potentially affected by noise trading, transaction costs, finite risk-bearing capacity of investors, impossibility of arbitrageurs to hold their positions in situations when prices deviate severely from fundamental values, fear of loss limiting the original arbitrage position, cost of learning about the valuation of a particular security are actually real-life situations that more than often confine arbitrageurs' actions.

In real markets, noise trading or actions based on investor sentiment put further limits on arbitrage, but only in the situations where the duration of noise traders' misperception is of the same order or magnitude as or longer than the horizon of the arbitrageurs. In this particular case, an extremely important potential cost of arbitrage is represented by the challenges imposed by the mechanics of short selling. In order to sell short a security, an arbitrageur must borrow it from a broker and finding such an intermediary can prove to be challenging. Moreover, short-selling can be prohibited in some regions or restricted by law, the finding of securities to buy or sell is often difficult and the arbitrageur is subjected to the risk that the broker can withdraw from the market. In the case of imperfect substitutes, arbitrage becomes even more risky because the prices of close substitutes can diverge from fundamental values not just for causes like investor's sentiment[2]. Moreover, noise traders who create additional risk by trading in a random way can lead to the creation of mispricing. This additional risk is priced by the market according to standard financial theory. If the noise traders accept this additional risk they can obviously earn higher returns than rational investors (DeLong et. Al, 1990). In other words, irrational investors are not necessarily eliminated from the market as the EMH implies.

In addition to the evidence presented until now, another strong empirical piece of evidence that contradicts the third theoretical pillar of the EMH is the existence of bubbles and crashes generated by one of the oldest theories about financial markets, the price-to-price feedback. The mechanism behind this theory begins with increases in speculative prices that lead to increases in welfare for some investors, which further generate word-of-mouth enthusiasm and feed expectations for future price increases which in turn increase investors' demand and generates another round of price increases. This recurrent set of causalities will give rise to a speculative "bubble" that is self-limiting in the sense that it will eventually burst when the high prices will not be sustainable any more Schiller (2000). The same method of rationing can be applied in the opposite way, meaning that negative feedback can also depress prices to an unrealistic level. Moving forward to the empirical challenges, Fama (1991) argues that market efficiency per se cannot be testable unless it is tested jointly with some model of equilibrium such as an asset-pricing model. Regardless of that, empirical tests have resulted in important challenges to the efficiency hypothesis, starting with the weak form.

Observed studies over the last 30 years indicating pricing anomalies such as seasonals in returns, the excess volatility of returns and positive or negative autocorrelation of short term returns demonstrated that future returns are to some extent predictable, based on past information and therefore markets deviate from the efficiency status. Moreover, returns of stocks with low market capitalization have been higher on average than returns of stocks with high market capitalization (the size effect) (Banz, 1981). Returns on value stocks such as stocks with a high dividend yield, a low price/earnings ratio or a high book-to-market ratio have been on average higher than returns of growth stocks, namely stocks with a low dividend yield, a high price/earnings ratio or a low book-to-market ratio. Also, specific events such as earnings announcements or stock splits may predict subsequent security returns (Fama, 1991). Furthermore, there is evidence of several trading strategies earning significant profits throughout history. One example of such a trading pattern is

[2] For example, when a stock is included in the S&P 500 index, the inclusion is normally accompanied by a share price increase without any fundamental good news related to the company.

built on the observation that while on the short term prices can show a momentum pattern, on the longer term, the overreaction of stock prices to relevant news implies that extreme stock market performance tends to reverse itself. The stocks that have performed best in recent past are likely to underperform the rest of the market in the following periods, while the worst past performers tend to offer above average future performance (Lakonishok et al., 1994). This phenomenon would imply that a contrarian investment strategy – investing in recent "losers" and avoiding recent "winners" should prove profitable. An opposite example is the momentum strategy in which stocks with high returns over the last three to twelve months ("winners") are bought and low-return stocks ("losers") over the same period are sold in such a way that the short-selling of "losers" finances the buying of "winners". After a holding period of 12 months, the "losers" are bought back and the "winners" are sold. Jegadeesh and Titman (1993) demonstrated that for U.S. stocks this strategy resulted in significant profits. Nevertheless, the validity of the empirical challenges holds just as long as the findings prove to be real profit opportunities and not just expected rewards for bearing a certain amount of risk. Debate continues as to whether this is actually the case in the present financial markets.

2. Methodology

In capital markets research, studies of the semi-strong form of the efficient markets hypothesis can be categorized as tests of the speed of adjustment of prices to new information (Kothari and Warner, 2006). The principal research tool in this area is the event study, which allows us to make inferences regarding the efficiency hypothesis by assessing the financial impact of corporate events on the behavior of firms' stock prices. An event study averages the cumulative performance of stocks over time, from a specified number of time periods before an event to a specified number of periods after the event. The underlying assumption is that, taking into consideration the rationality of the market place, information disclosed by events will be reflected immediately in security prices. In other words, systematically nonzero abnormal security returns that persist after a particular type of corporate event contradict the market efficiency hypothesis.

The evolution of research methods related to event studies over the past years has been considerable. Nevertheless, the statistical format is still based on the seminal studies performed in the late 1960s by Ball and Brown (1968) and Fama et al. (1969) which maintained as a key research focus the measurement of sample securities' mean and cumulative return around the time of the event. Empirical research in finance related to event studies has revealed two types of regularities: short term under reaction to news, demonstrating that prices reflect new information slowly and long term overreaction, where stock prices exhibit negative autocorrelations. Several empirical approaches identified different patterns in prices evolution as a consequence of the event impact and associated various behavioral explanations such as positive feedback (Hong and Stein, 1999), overconfidence Daniel et al. (1998), or anchoring and representativeness (taken into account simultaneously by Barberis et al. (1998)). Shleifer (2000) identifies underreaction when the average return on the company's stock in the period following an announcement of good news (i.e. after the initial price reaction to the news) is higher than the average return in the period following bad news. In the event study to be described in the next section, news is represented by earnings announcements and the underreaction to the actual announcement is expected to result in a potential for profitable trading in the stock after the event, which is considered to contradict the predictions of the semi-strong form of market efficiency.

At an explanatory, intuitive level, the mechanism of the model should imply conservatism as a first behavioral explanation, in the sense that before the event of earnings announcement investors should have already formed a general opinion regarding the valuation of the company and as a consequence, they do not adjust their valuation in accordance to the news as much as Bayesian statistics would require. Individuals subject to conservatism might therefore disregard the full information content of an earnings announcement perhaps because they believe that the value contained in the news implies a large temporary component and is still influenced by the prior earnings estimates. This behavior results in underreaction of prices to earnings announcements and to short term trends.

However, on the long term as a response to repeated pieces of similar information (either bad or good), people tend to believe that positive surprises in earnings announcements are representative of a good company and therefore underestimate the possibility that the good news would be also a result of other factors such as chance, which consequently results in overreaction. Kahneman and Tversky (1973) define the representativeness heuristic as follows: "A person who follows this heuristic evaluates the probability of an uncertain event, or a sample by the degree to which it is (i) similar to its essential properties to the parent population, (ii) reflects the salient features of the process by which it is generated".

Representativeness is therefore followed by overreaction on the longer time horizon. Overreaction is defined by Shleifer (2000) as occurring when the average return following not one but a series of announcements of good news is lower than the average return following a series of bad news announcements. The idea is that after a series of announcements of good news, the investor becomes overly optimistic that future news announcements will also be good and hence overreacts, resulting in an unjustifiably high level of stock prices. Subsequent news is likely to contradict his optimism, leading to lower returns. We therefore expect the findings to point to the conclusion that stale information, namely the earnings surprise has predictive power for future risk-adjusted returns.

Some other underlying evidence to the initial underreaction of investors could be represented by the momentum phenomenon, where positive autocorrelations of returns over relatively short horizons could demonstrate a slow incorporation of news into stock prices. On the other hand, the overreaction evidence should prove that, over longer horizons, security prices overreact to consistent patterns of news pointing in the same direction. Well performing securities usually receive extremely high valuations that on average return to the mean.

2.1. General approach

Past studies regarding the effect that specific events have on the evolution of firms' securities prices and implicitly on returns revealed a general guiding framework that can be applied when conducting a specific event study (Campbell et al., 1997). The first step is represented by the definition of the event of interest and identification of the period over which the security prices of the firms involved in this event will be examined, namely the event window, which is usually defined to be larger than the specific period of interest, in order to allow for examination of the periods surrounding the event. The second step following the identification of the event is represented by determination of the selection criteria for the inclusion of a given firm in the study. It is useful to point out that the selection criteria is usually affected by restrictions such as the ones imposed by data availability, membership in a specific industry, or capital market defined by the borders of a particular country. When selecting the input data it is also recommended to pay attention to any potential biases resulted from the selection of the sample. The third step is represented by the computation of the abnormal return, namely the actual ex post return of the security over the event window minus the normal return of the firm over the event window, which is not conditioned on the event taking place. For a particular firm *i* and an event date τ, the abnormal return can be computed using the following formula:

$$AR_{\iota\tau} = R_{i\tau} - E(R_{i\tau} \mid X_{\tau}) \quad (1)$$

where $AR_{\iota\tau}$, $R_{i\tau}$, $E(R_{i\tau} \mid X_{\tau})$ represent the abnormal, actual and normal returns for the period τ. X_{τ} represents the conditioning information for the normal return model, obtained either by employing the constant mean return model, where X_{τ} is constant, or the market model where X_{τ} is the market return, or other multifactor models.

After deciding upon the normal performance model, the next step is defining the estimation window, most of the times by using the exact period prior to the event window. Nevertheless, the event period should not be included in the estimation period, in order to prevent the event from influencing the normal performance model parameter estimates.

Following the computation of the abnormal returns characterizing the event window, the testing framework has to be designed in order to be able to make inferences regarding the efficiency of the market. Important considerations included at this step are defining the null hypothesis and determining the techniques for aggregating the individual firm abnormal return. The p-value, or the lowest significance level at which a null hypothesis can be rejected will be used in order to draw conclusions regarding predictions of the null hypothesis. After performing the test statistic, the empirical results will be presented and interpreted.

2.2. Data

Event studies provide an important research tool for examining the information content of disclosure and particularly the way in which the information is included in stock prices. The present event study will analyze the influence that earnings announcement – both quarterly and annual – have on the stock prices of a series of companies. We investigate the way in which the disclosure of accounting information influences the evolution of prices within the financial capital markets and find corresponding behavioral justifications.

We hypothesize that markets are not characterized by efficiency and therefore alternative patterns of behavior such as underreaction or overreaction, generated by biases such as representativeness or momentum are more appropriate to explain why prices reflect new information only slowly on the short term, while on the long term, returns tend to revert to the mean.

The analysis will therefore focus on the quarterly and annual earnings announcements of a series of companies trading on a developed market (Austria) and an emerging market (Poland) over the five year period from July 2005 to June 2010. These announcements correspond to the quarterly earnings for the third quarter of 2005 to the second quarter of 2010 and annual earnings announcements correspond to the years 2005-2010. The samples comprised 98 Austrian companies and 100 Polish companies. For the Austrian market, we constructed a sample of 344 events – 163 quarterly and 181 annual. For the Polish market, we identified 228 earnings announcements – 70 quarterly and 158 annual. For each firm and quarter, we recorded the date of the announcement and the percentage surprise resulted from the difference between the actual earnings and the expected earnings. The data were obtained from Thomson Reuters. The mean quarterly earnings forecast, used to compute the earnings surprise, was reported by the Institutional Brokers Estimate System (I/B/E/S). I/B/E/S compiles forecasts from analysts for a large number of companies and reports summary statistics each month.

As in the standard event study framework (Fama, 1970), we classified the announcements into three categories: good news, bad news and no news, depending on the value and sign of the percentage earnings surprise. The classification of events according to good, bad or no news was made in relation to a 5% deviation from expected earnings. For example, if the actual earnings exceed the expected earnings by more than 5%, the announcement is designated as good news, while if the actual level of earnings falls under 95% of the estimated level, the announcement is designated as bad news. Announcements for which the actual earnings are in the 10% range centered around the expected earnings are considered no news.

Of 163 quarterly earnings announcements in Austria, 58 were good news, 27 – no news and 78 – bad news. Furthermore, out of 181 annual earnings announcements, 51 were considered good news, 67 – no news and 63 – bad news. Moving on to the analysis of Poland, out of the 158 annual earnings announcements, 44 were good news, 65 – no news and 49 – bad news. Finally, of the 70 quarterly earnings announcements, 26 were good news, 10 – no news and 34 – bad news.

After classifying the announcements, we specified the parameters of the empirical design to analyze the equity returns (the equity prices were extracted from the Reuters 3000Xtra database and transformed into logarithmic returns). We used several windows for each categorization of news: a 21-day event window (10 pre-event days and 10 post-event days); a 41-day event window (20 pre-event days and 20 post-event days); and a 61 event window (30 pre-event days and 30 post-event days). The size of the estimation window was fixed at 250 days prior to the event.

2.3. The market model

A number of approaches are available to calculate the normal return of a given security. We use the market model as a statistical model that relates the return of any given security to the return of the market. The model's linear specification follows from the assumed joint normality of asset returns. For any security i, the market model is represented by the following equation:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (2)$$

$$\varepsilon_{it} = 0 \quad (3)$$

$$Var(\varepsilon_{it}) = \sigma^2 \varepsilon_i \quad (4)$$

where R_{it} and R_{mt} are the period-t returns on security i and the market portfolio, respectively and ε_{it} is the zero mean disturbance term. α_i, β_i and $\sigma^2\varepsilon_i$ are the parameters of the market model. As a proxy for the market portfolio of Austria, the market model employed in the present study uses the ATX – the Austrian Traded Index, which is the most important stock market index of the Austrian market. For Poland, the WIG, the main stock market index was considered the proxy for the market portfolio. The choice of this particular model for obtaining the normal returns in the event window is motivated by results of previous studies that demonstrate several improvements that the market model brings over previous employed models such as the constant mean return model. The market model takes into account the variation in the market's return and as a consequence reduces the total variance of the abnormal returns.

2.4. Analysis framework

We follow the standard notation of Campbell et al. (1997) and index returns using τ. Defining τ=0 as the event date, $\tau=T_1+1$ to $\tau=T_2$ is the event window, and , $\tau=T_0+1$ to $\tau=T_1$ is the estimation window. Let $L_1=T_1-T_0$ and $L_1=T_2-T_1$ be the length of the estimation window and the event window respectively. Sometimes researchers consider a post-event window from $\tau=T_2+1$ to $\tau=T_3$, but for our purposes the event window suffices. The estimation and the event windows do not overlap, which maintains the parameters for the normal return model free of any influence from the event-related returns.

2.5. Estimation of the market model

Expressing the estimation-window as a regression system yields:

$$\mathbf{R}_i = \mathbf{X}_i \boldsymbol{\theta}_i + \boldsymbol{\varepsilon}_i \tag{5}$$

where $\mathbf{R}_i = [R_{iT_0+1} \cdots R_{iT_1}]'$ is an $(L_1 \times 1)$ vector of estimation-window returns, $\mathbf{X}_i = [\boldsymbol{\iota}\ \mathbf{R}_{im}]$ is an $(L_1 \times 2)$ matrix with a vector of ones in the first column, and $\boldsymbol{\theta}_i = [\alpha_i \beta_i]'$ is the (2×1) parameter vector. The efficient OLS estimators of the market model parameters using an estimation window of L_1 are:

$$\hat{\boldsymbol{\theta}} = (\mathbf{X}_i'\mathbf{X}_i)^{-1}\mathbf{X}_i'\mathbf{R}_i \tag{6}$$

$$\hat{\boldsymbol{\sigma}}_{\varepsilon i}^2 = \frac{1}{L_1 - 2}\hat{\boldsymbol{\varepsilon}}_i'\ \hat{\boldsymbol{\varepsilon}}_i \tag{7}$$

$$\hat{\boldsymbol{\varepsilon}}_i = \mathbf{R}_i - \mathbf{X}_i\hat{\boldsymbol{\theta}}_i \tag{8}$$

$$Var[\hat{\boldsymbol{\theta}}_i] = (\mathbf{X}_i'\mathbf{X}_i)^{-1}\sigma_{\varepsilon_i}^2 \tag{9}$$

Given the market-model parameter estimates, let $\hat{\varepsilon}_i^*$ be the $(L_2 \times 1)$ sample vector of abnormal returns for company *i* from the event window, T_1+1 to T_2. The abnormal return vector is:

$$\hat{\boldsymbol{\varepsilon}}_i^* = \mathbf{R}_i^* - \mathbf{X}_i^*\hat{\boldsymbol{\theta}}_i \tag{10}$$

where $\mathbf{R}_i^* = [R_{iT_1+1} \cdots R_{iT_2}]'$ is an $(L_2 \times 1)$ vector of event-window returns, $\mathbf{X}_i^* = [\boldsymbol{\iota}\ \mathbf{R}_{im}^*]$ is an $(L_2 \times 2)$ matrix with a vector of ones in the first column and the vector of market return observations $\mathbf{R}_{im}^* = [R_{mT_1+1} \cdots R_{mT_2}]'$ in the second column $\hat{\theta}_i = [\hat{\alpha}_i \hat{\beta}_i]'$ is the (2×1) parameter vector estimate. Under the null hypothesis H_0 that the given effect has no impact on the mean or variance of returns, the vector of event-window sample abnormal returns is normally distributed with mean 0 and conditional variance $\mathbf{V}_i, \hat{\boldsymbol{\varepsilon}}_i^* \sim N(0, \mathbf{V}_i)$. Next, we aggregate the abnormal returns through time and across securities. We make the standard assumption that the abnormal returns and the cumulative abnormal returns will be independent across securities. We define $\overline{\boldsymbol{\varepsilon}}_i^*$ as the sample average of *N* abnormal returns obtained from *N* events. Then,

$$\overline{\varepsilon^*} = \frac{1}{N}\sum_{i=1}^{N}\hat{\varepsilon}_i^* \tag{11}$$

$$Var[\overline{\boldsymbol{\varepsilon}}_i^*] = \frac{1}{N^2}\sum_{i=1}^{N}\mathbf{V}_i \tag{12}$$

To aggregate the elements of the vector of abnormal returns through time we define $\overline{CAR}(\tau_1, \tau_2)$ as the cumulative abnormal return from τ_1 to τ_2, $T_1 < \tau_1 \le \tau_2 < T_2$

and γ as a $(L_2 \times 1)$ vector with ones in position $\tau_1 - T_1$ to $\tau_2 - T_1$ and zeroes elsewhere. We write:

$$\overline{CAR}(\tau_1, \tau_2) = \gamma' \overline{\boldsymbol{\varepsilon}}_i^* \tag{13}$$

$$Var[\overline{CAR}(\tau_1, \tau_2)] = \overline{\sigma}^2(\tau_1, \tau_2) = \gamma' \mathbf{V} \gamma \tag{14}$$

Since the event windows of the N securities do not overlap, the covariance terms are zero. Then, the cumulative average abnormal $\overline{CAR}(\tau_1, \tau_2) \sim N(0, \overline{\sigma}^2(\tau_1, \tau_2))$. To test the null hypothesis that the expectation of abnormal returns is zero, we can define the statistic:

$$J_1 = \frac{\overline{CAR}(\tau_1, \tau_2)}{[\overline{\sigma}^2(\tau_1, \tau_2)]^{1/2}} \sim N(0,1) \tag{15}$$

3. Results

3.1. Austria

Focusing now only on the announcement day (day zero) for quarterly earnings announcements in all 6 scenarios characteristic to each country, the sample average abnormal return for the Austrian good news firms, for an event window of 21 day, is 1.24%. Given the standard error of the one day good news average abnormal return is 1.5%, the value of J_1 is 0.38, which results in a p-value higher than 5%, giving us insufficient statistical evidence to refute the null hypothesis. The story is similar for the no news and bad news scenario, and for the annual earnings announcements. Enlarging the event window to 41 days, we obtain for the good news firms a sample average abnormal return of 1.26% in the case of quarterly earnings announcements, and a corresponding standard deviation of 2.1% leading to a J_1 equal to 0.51, a p-value of 30.36% and insufficient statistical evidence to reject the null hypothesis, result which is also characteristic to the no news and bad news scenarios. However, for the good news firms which make annual earnings announcements the story changes for the 41 event window. The average sample return is 0.78%, the corresponding value of J_1 is 1.88, and the p-value for this case is 3.01% and the null hypothesis that the event has no impact is strongly rejected. Similar results are obtained for an event window of 61 days. In the case of quarterly earnings announcement, there is not enough statistical evidence to reject the null hypothesis. Only for the good news firms responding to annual earnings announcements, the p-value is lower than 5% (4.67%). The average abnormal return in this case is 0.97%, the corresponding standard deviation from the sample mean is 2.28%, J_1 is 1.68 and the null hypothesis is rejected. We may thus conclude that the announcement has a significant impact on the value of the sample companies.

3.2. Poland

The analysis of an emerging market, as expected from the start, provides much more statistical evidence for the rejection of the null hypothesis that the events have no impact on the corresponding values of securities' prices. Starting with the analysis of a 21-days event window, we obtain a 0.85% average abnormal return in the case of no news firms and a corresponding sample standard deviation equal to 2.63% , which result in a J_1 of 1.81 and a p-value of 3.53%. The story is the same for the bad news scenario. The average abnormal return in this case is, as expected, lower than in the previous case (equal to -1.06%) and J_1 is -3.36. Therefore, there is enough statistical evidence to reject the null hypothesis even at a 1% significance level (the p-value is 0.04%). For the annual earnings announcements, characteristic to a 21-days event window statistical evidence that could help us reject the null hypothesis proves significant only in the case of bad news firms. The average abnormal return in the announcement day is -0.96%, the sample standard deviation is 1.29%, J_1 is -2.82 and p-value is lower than 1%. Enlarging further the event window to 41 days, we reject the null hypothesis that quarterly earnings announcements have no impact on the firms, both in the case of positive news (positive surprises in earnings announcements) and bad news (negative surprises – earnings of firms were lower than estimated). The average abnormal return obtained was -0.96% for the good news scenario, with a corresponding standard deviation of 2.39% and -1.04% for the bad news firms with a standard deviation of 1.97%. In the case of annual earnings announcements, the null hypothesis is rejected only for the bad news firms, with a corresponding p-value of 4.83%. For a 61-days event window, the fact that quarterly earnings announcements influence the evolution of security prices is corroborated by evidence both in the case of good news and bad news firms. For the good news firms we obtained a sample average abnormal return of -1.03% in the announcement day, a standard deviation equal to 3.05% and a J_1 of 1.88. The p-value is lower than the significance level, so the null hypothesis is rejected. The same thing happens for the bad news firms, where p-value equals 1.4%. As in the case of the 41 event window, when analyzing annual earnings announcements, the null hypothesis can be rejected only in the case of bad news companies. In this particular case the average abnormal return is -1.03%, J_1 is -1.9 and the p-value is lower than 5%.

3.3. Behavioral interpretation

The results confirm previously documented phenomena. First, the market reaction captured by the cumulated abnormal returns is not immediate. As can be observed in Figure 1, cumulative abnormal returns for the event window comprising 61 days are generally greater than those for short term windows, denoting a progressive reaction to the earnings announcements. The results are the same for annual earnings announcements, as can be observed in Figure 1.

Second, representativeness bias could be a source for the observed overreaction phenomenon. Investors that exhibit representativeness extrapolate their information too far in the future. As on average these extreme expectations are not confirmed by actual surprises there should be periodical corrections.

The representativeness bias implies that people rely too heavily on information gathered from small samples (the law of small numbers). As a consequence, a series of similar pieces of news may be construed as a pattern and extrapolated too far into the future as observed in the present example.

Figure 1. Cumulative abnormal returns for quarterly announcements

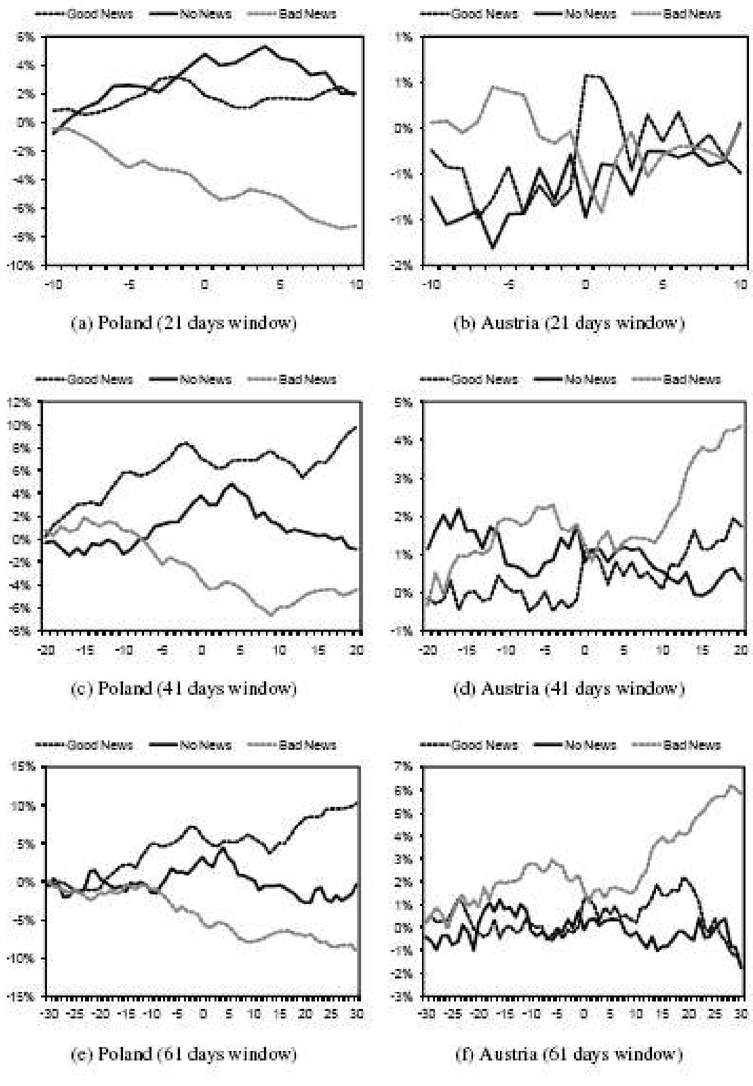


Figure 2. Cumulative abnormal returns for annual earnings announcements

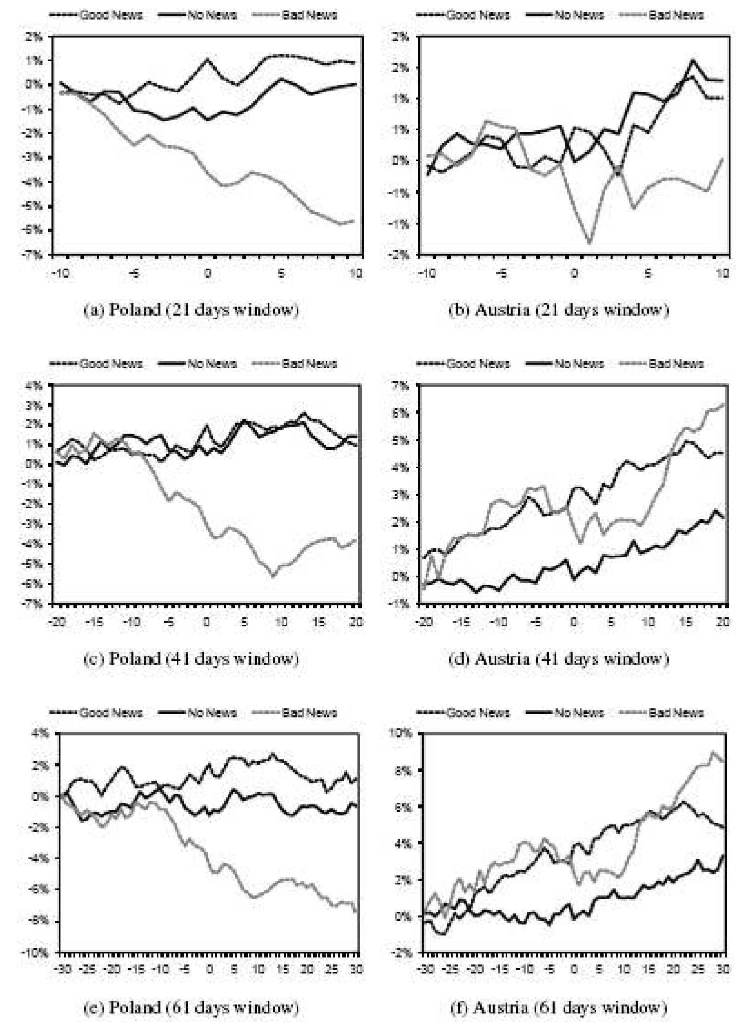
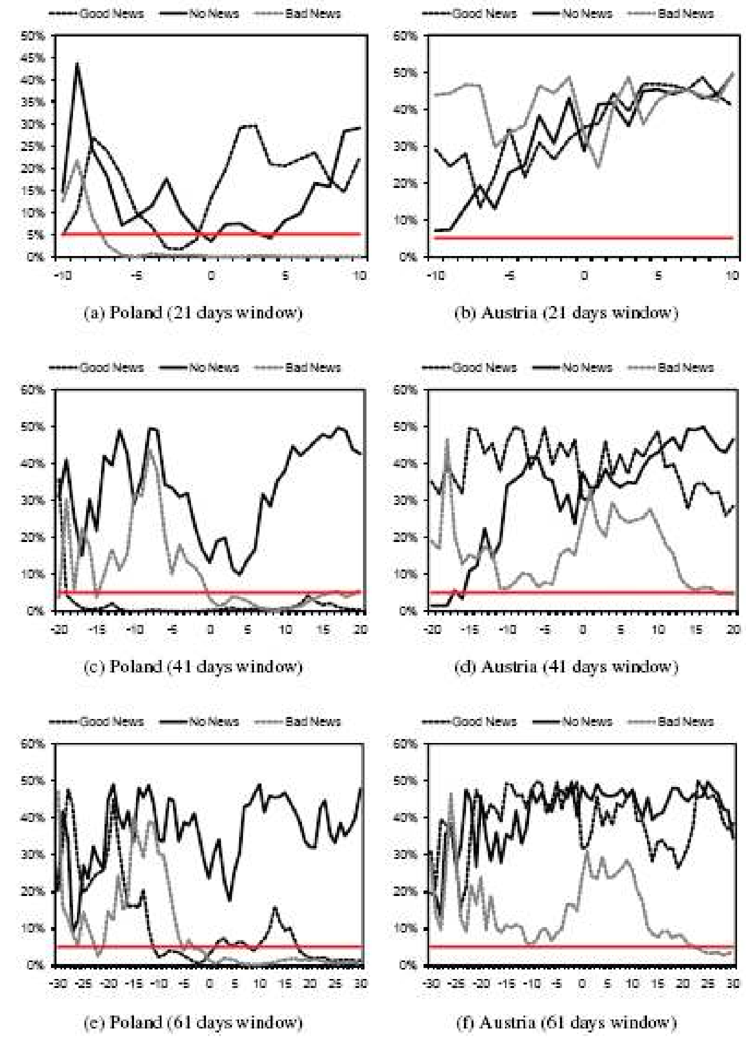


Figure 3. P-values for J_1 statistics



(a) Poland (21 days window)
(b) Austria (21 days window)
(c) Poland (41 days window)
(d) Austria (41 days window)
(e) Poland (61 days window)
(f) Austria (61 days window)

4. Conclusions

We presented the results of a comparative analysis of Austrian and Polish companies earnings announcements. Our results indicate that the Austrian market is more efficient, since there is no statistical evidence to reject the hypothesis that earnings surprises have an impact on the behavior of returns. The Polish market, however, appears to adjust slowly to new information. The returns of companies whose earnings turn out to be good news for investors seem to gradually drift up over the period of the event window, while the reverse is true for the returns of companies whose earnings are lower than forecasted.

The econometric model used for the construction of the event study relies on several limiting assumptions that restrict its power to test the efficiency of markets. A more thorough analysis of quarterly or annual earnings announcements should probably take into account more of the complexities implied by the realities of the marketplace. Alongside with the limiting assumptions regarding the construction of the event study, the indication provided by the study that anomalous stock price behavior around earnings announcements could be based on representativeness is constructed mostly on general assumptions and previous empirical evidence, the statistical data being insufficient for constructing an explanatory model.

However, there is strong statistical evidence that in our research design both the Polish and the Austrian markets are efficient, but that on the Austrian market there are fewer opportunities for investors to predict the evolution of a company's returns based on the nature of an earnings surprise.

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