Testing Semi-Strong Form Efficiency and the PEAD Anomaly in ATHEX
An Event Study based on Annual Earnings Announcements

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Abstract

Semi-strong form efficiency is generally supported by event studies, especially these on daily returns testing the market’s reaction to accounting earnings. Nevertheless, the Post-Earnings-Announcement Drift (PEAD) anomaly, being inconsistent with semi-strong form efficiency, seems to have survived robustness tests through years. This paper examines the reaction of ATHEX in response to fiscal year’s 2006 annual earnings announcements of 20 high capitalisation companies. The common event study methodology is being used in order to define expected returns and trace the abnormal performance of these stocks. Three portfolios are constructed based on the unexpected component of the reported earnings per share (EPS). The abnormal performance of each portfolio over time is identified by the daily Cumulative Average Abnormal Returns (CAAR). The results of this research reveal that ATHEX gradually reacts prior to the earnings announcements, resulting in weak price adjustment on the announcement day. The limited presence of the PEAD anomaly is not considered to be very statistically significant. The outcome of this research is that ATHEX should be considered as near efficient during that period, bearing in mind that it fairly succeeds in revising its estimates so as to prohibit the emergence of exploitable inefficiencies.
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This thesis is dedicated to the memory of my father, 

IOANNIS S. DERDAS, 

who passed away after a meaningful life 

that I would be honoured to emulate.
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1.0 Introduction

Efficient Market Hypothesis (EMH), attributed to Fama (1970), remains one of the most sound fields of debate between academics and practitioners. The vast majority of researchers have been concerned with the semi-strong form of EMH. Semi-strong form efficiency implies that shares are correctly priced, in the sense that the market is able to reflect all publicly available information in the share price.

Although the amount of information “hitting” stock markets on a daily basis is countless, accounting earnings, being incorporated in the financial statements of listed companies, comprise the most readily available type of information for investors. Ball and Brown (1968) were the first who examined the market’s reaction to annual earnings announcements in the United States and since then, an extensive literature has been provided. Furthermore, the Post-Earnings Announcement Drift (PEAD) anomaly, which directly challenges semi-strong form efficiency, was originally identified in Ball and Brown’s research and since then, it has been replicated consistently by many studies. Despite the fact that the survival of this anomaly has induced researchers to provide possible explanations, the mechanism behind it remains elusive.

The available literature in emerging markets as well as in the Greek stock exchange market (ATHEX) is rather limited. As far as it concerns ATHEX, empirical evidence has mainly focused on the information content of earnings and the earnings-returns association while, apart from the early research of Niarchos and Georgakopoulos (1988), it has not been possible to identify more recent studies being occupied with ATHEX’s reaction in response to earnings announcements and the PEAD anomaly.
This paper is considered to contribute to the existed literature in the following ways. First, this research is applied to the most recent period as possible, meaning to fiscal year’s 2006 earnings announcements. Second, the fact that the earnings figures of that year were reported according to the *International Financial Reporting Standards* (IFRS) should be regarded as an extra contribution, bearing in mind that the available literature in ATHEX has been based on the former Greek *General Acceptable Accounting Principles* (GAAP).

The purpose of this research is to examine if ATHEX is proved to be semi-strong form efficient based on its reaction to annual earnings announcements and subject to investigate the PEAD anomaly. The results are consistent with the view that ATHEX should be considered as *near efficient* during the period tested, and the PEAD anomaly, although present, would not be able to comprise an *exploitable inefficiency*.

The remainder of this thesis is organised as follows. Section 2 reviews the literature regarding the EMH and the semi-strong form efficiency. In addition, empirical evidence from developed and emerging capital markets as well as from ATHEX, with respect to the market’s reaction to accounting earnings and the PEAD anomaly, is included. Section 3 describes the general characteristics of ATHEX along with the accounting information provided by the listed companies. Section 4 constitutes the empirical section of this thesis, incorporating the data, the methodology, and the reported results. Finally, section 5 summarises the results and provides the concluding remarks of this paper.
2.0 Literature review

2.1 Efficient Market Hypothesis (EMH)

Efficient Market Hypothesis (EMH), being interdependent with informational efficiency, first showed up as a notion in early years by the French Louis Bachelier (1900), who implied the random walk of asset prices in his doctoral thesis, and before being generally accepted among researchers. However, EMH is commonly attributed to Fama (1970) who made it a prominent theory and declared: “A market in which prices always fully reflect available information is called efficient”.

Shleifer (2000) provided the conditions of market efficiency:

(i) **Rationality**: All investors are assumed to behave rationally when new information is released into the market.

(ii) **Independent deviations from rationality**: It is more likely that some investors act in an optimistic manner so that the stock price will rise above than market efficiency would predict, and, at the same time, some other investors are more pessimistic so that the stock price will rise less than predictions. Ross et al. (2008) asserts that if the proportion of the former is of equal size to the proportion of the latter, then, the drift of the stock price will be consistent with efficient markets. In other words, the offsetting behaviour of different types of investors is adequate in order to ensure market efficiency.
(iii) Arbitrage: According to Ross et al. (2008) arbitrage is defined as “…the simultaneous purchase and sale of different, but substitute, securities” in order to profit from price discrepancies. Nevertheless, arbitrage might be limited, as it is unlikely for investors to find a portfolio of substitute securities in the real world (Shleifer, 2000).

Keane (1983), a keen proponent of market efficiency, classified EMH as an empirical issue that makes no assumptions and claimed that if empirical studies were able to prove that the share price reflects the market’s best estimate, then, one might reasonably presume the existence of a considerable amount of rational and well-informed investors.

2.2 The three forms of market efficiency

Fama (1970) distinguished the levels of market efficiency according to the type of information involved.

Weak-form efficiency

The market is said to be weak-form efficient if “share prices fully reflect the information implied by all prior movements” (Keane, 1983). This statement implies that share prices should follow a random walk, meaning that past stock price information is already fully incorporated by the stock market. As a result, it is rather impossible for investors to profit by simply studying charts and following patterns in stock price movements, implying that only new information released into the market should be under investors’ consideration.
Tests of weak-form efficiency are usually undertaken under two approaches, meaning tests of the random walk and tests of trading strategies related with past price performance. According to empirical evidence, the former tests seem to support weak-form efficiency while the latter, although rejecting the random walk by using specific strategies (e.g. filter techniques and hedging strategies), reveal that the available profit opportunities to investors are unable to compensate them with returns above the normal rate when taking into account transaction costs (Alexander, 1961; Fama and Blume, 1966; Keane, 1983; Ma, 2004). In general, the majority of empirical evidence regarding weak-form efficiency seems to support the theory and the random walk (Beechey et al., 2000). Nevertheless, this research is focused on the market’s reaction to new information, meaning the semi-strong form of market efficiency.

**Semi-strong form efficiency**

Ross et al. (2008) state: “A market is semi-strong form efficient if prices reflect (incorporate) all publicly available information, including information such as published accounting statements for the firm as well as historical price information”. Therefore, semi-strong efficiency requires not only historical price information reflected in stock prices but also all information available to the public, implying that if the market is semi-strong form efficient, it should be weak-form efficient as well. Keane (1983) asserted, in a more precise manner, that the market is semi-strong form efficient when “share prices respond instantaneously and without bias to newly published information”, emphasising the irrelevance of past information which is already reflected in the stock price.
According to semi-strong form efficiency, the market’s reaction to publicly available information should be instantaneous and unbiased in order to eliminate investors’ expectations for abnormal returns. Instead of the terms instantaneous and unbiased, Shleifer (2000) referred to the speed and correctness of the market’s reaction to new information. The term speed implies that investors will not be able to profit by using this new information, as all available information is already reflected in the share price. The term correctness refers to the quality of the market’s adjustment to new information. This adjustment should be accurate so that no systematic patterns of under/over-reaction turn up. In fact, the direction and the magnitude of the market’s adjustment as well as the speed with which the market responds to new information are both of the same importance. The notion of semi-strong efficiency might be illustrated graphically as follows:

Assuming an efficient market and the announcement of favourable information (i.e. good news), the share price should drift upwards on the announcement day (day 0) while during
the days following the announcement no further reaction should be reported\(^1\). A further reaction (overreaction) or a delayed response (underreaction) during the days following the announcement would suggest an inefficient market\(^2\). Nevertheless, according to Keane (1983), any inefficiency should be *exploitable* in order to be acceptable, a view which will be discussed later in this section. Semi-strong form efficiency is generally tested under two approaches: the *direct* and *indirect* method.

**Direct method**

The so-called *event studies* are the appropriate direct tests regarding semi-strong form efficiency. The purpose of these studies is to identify the market’s reaction to published information and events (Keane, 1983). The type of information on which this research is based, meaning the annual earnings announcements of listed companies on ATHEX, is probably the most popular accounting information encompassed in financial statements. Other examples of publicly available information and events are dividends announcements, stock splits, mergers and acquisitions, and many more. The broad range of accounting and other information as well as their relationship with stock price performance has made event studies an empirical field of great importance in testing the semi-strong form of the EMH.

In general, event studies report mixed evidence regarding market efficiency. A detailed review of this literature with respect to accounting earnings information is provided later in this section.

**Indirect method**

*Performance evaluation studies* constitute the indirect method of testing semi-strong form efficiency and are focused on the *users* of publicly available information, meaning

\(^1\) See ‘efficient market response’ in figure 1.
\(^2\) See the dashed lines in figure 1.
investors, and how they manage to perform against a broad-based market index. The idea behind these studies is to compare the performance of professionally managed funds against a *buy-and-hold-the-market* strategy. To put it more straightforward, the comparison is simply between an active and passive strategy. Early empirical evidence, being in favour of market efficiency, showed that even the most actively managed funds are unable to outperform a passive strategy (Jensen, 1967). It is worth noticing here that the indirect method seems far more capable than the direct method in order to support semi-strong form efficiency because the amount of market-based information is inexhaustible and any skilled “enemy” of market efficiency might argue that a certain combination of specific information gives him the superiority to earn abnormal returns (Keane, 1983). Nevertheless, this research is occupied with the direct method of semi-strong form efficiency.

**Strong form efficiency**

Strong form efficiency implies that the market is efficient if “*share prices fully reflect not only published information but all relevant information including data not yet published*” (Keane, 1983). In other words, according to this form of efficiency, even the *insiders*, meaning investors who have access to inside information, would not be able to profit by exploiting their “blessing” status. Therefore, it would be common sense to assert that strong form efficiency is unlikely to exist, and, not surprisingly, empirical evidence supports the view that markets are inefficient in the strong form and insiders do outperform the markets’ estimates by trading either legally or not (Shleifer, 2000).
2.3 Inefficiency issues

Since the advent of the EMH and the three forms of market efficiency, a considerable debate has been existed between those believing that it is possible to beat the market and those believing that, although it is possible for few investors to make abnormal returns, the rationale for the majority of investors should be the least-cost strategy, meaning to believe that the market is efficient until exploitable inefficiencies are identified. To a great extent, the former believers seem to originate from the group of practitioners while the latter are mainly academics.

According to Keane (1983), an exploitable inefficiency should be:

(i) **Authentic**: In other words, it should be supported by proper statistical research.

(ii) **Identifiable**: Investors should be able to identify specific strategies of skilled experts that might be able to systematically beat the market and sort them out from naive and less successful strategies.

(iii) **Material**: Any inefficiency should be regarded as exploitable if and only if it is capable to compensate the user for the costs and risks taken in order to identify it.

(iv) **Persistent**: Even if a material inefficiency has been identified and authenticated, investors should be able to prove that it will remain in the future and the market will suffer from the lack of learning and revising its estimates.
Therefore, bearing in mind the above criteria, it might be deducted that the evidence for an *exploitable inefficiency* is far less than a clear-cut issue.

**2.4 Joint hypothesis problem**

All the three forms of market efficiency imply that investors should be unable to realise excess returns, meaning returns above the normal rate of return (adjusted for risk). This *normal (expected) return*, being mentioned early in this section, should be identified and measured by an *equilibrium asset pricing model*. The most popular models for this purpose are:

(i) The *Market Model* (MM) of Markowitz (1952) and Sharpe (1963).

(ii) The *Capital Asset Pricing Model* (CAPM) of Sharpe (1964) and Lintner (1965).

(iii) The *Arbitrage Pricing Theory* (APT), attributed to Ross (1976).

The *Market Model* is being applied in this research and will be reviewed later in the empirical section. What is of the essence here is that the use of an equilibrium model in order to define the normal rate of return implies that if true inefficiencies are reported and abnormal returns are realised, this could be only due to the following reasons:

(a) Either the market is truly inefficient, or

(b) The model applied in order to define the normal return is inadequate.
Therefore, the rejection of the EMH becomes clearly uncertain. However, this does not mean that testing the EMH is an uninteresting subject because researchers are still able to improve their understanding with respect to the stock price behaviour (Fama, 1991). Furthermore, the challenge of seeking *exploitable inefficiencies* has resulted in the rising of a special compartment of the *Efficient Market Theory*, known as *market anomalies*. This research is concerned with one of these anomalies: The *Post-Earnings-Announcement Drift (PEAD) anomaly*.

### 2.5 The PEAD anomaly

As Schwert (2002) states: “Anomalies are empirical results that seem to be inconsistent with maintained theories of asset-pricing behaviour. They indicate either market inefficiency (profit opportunities) or inadequacies in the underlying asset-pricing model”.

The *Post-Earnings-Announcement Drift (PEAD) anomaly* refers to the anomalous behaviour of stock prices when they continue to drift beyond the release of the earnings announcements. This research is interrelated to the PEAD anomaly, bearing in mind that our incentive is to investigate ATHEX’s reaction in response to annual earnings announcements on the announcement date as well as during the pre and post-announcement periods. The available literature regarding this anomaly is included within the empirical evidence of this section.
2.6 Motivation of the topic

What might be deducted at this stage is that the story regarding EMH seems quite turbulent and it would be rather rational to end this section with few major points in order to realise the motivation of this research and its focus on semi-strong efficiency and the PEAD anomaly:

(i) Bearing in mind that semi-strong efficiency implies weak-from efficiency and strong form efficiency is unlikely to exist, it should not be accidental the fact that the majority of researchers have focused on this form which virtually warrants the “efficient title” in capital markets.

(ii) During an edifying conversation in 1992, between Richard Roll, an academic and professional manager, and Robert Shiller, an economist who has provided an extensive literature in behavioural finance, Roll declared: “I have personally tried to invest money, my client’s money and my own, in every single anomaly and predictive device that academics have dreamed up...And I have yet to make a nickel on any of these supposed market inefficiencies...A true market inefficiency ought to be an exploitable opportunity” (Roll and Shiller, 1992). Therefore, Roll’s view seems highly consistent with Keane’s (1983) interpretation regarding exploitable inefficiencies.

(iii) According to empirical evidence, the majority of market anomalies tend to gradually disappear after the publicity of the initial researches regarding them (Fama, 1998; Schwert, 2002). However, according to Shiller (2003), the non-persistence of market anomalies should not be interpreted with an efficient market view, bearing in mind that it is natural
for gradually advanced knowledge to succeed in eliminating important findings as well as that it would be rather an exaggeration to expect inefficient patterns to happen frequently and last forever.

(iv) Finally, it is worth noticing that, on the one hand, event studies, especially those on daily returns, seem to provide the strongest evidence in favour of market efficiency (Fama, 1991), while, on the other hand, the PEAD anomaly has survived robustness tests through years (Fama, 1998). Therefore, in addition to the afore-mentioned, this paradox might be considered as an extra motivation of this research.

2.7 Empirical evidence

2.7.1 Developed markets

Ball and Brown (1968) were the first who investigated the market’s reaction with respect to annual earnings announcements in the United States. They used monthly stock returns of 261 firms listed on New York Stock Exchange (NYSE) regarding the fiscal years 1957-1965. Expected returns were defined with an Ordinary Least Squares (OLS) regression model and two expectations models were used in order to form market’s earnings forecasts\(^3\). Based on these forecasts, they distinguished between “good” and “bad news” portfolios, depending on if actual earnings either exceeded or fell behind forecasted earnings. One portfolio of the total sample was also included\(^4\). Lastly, the Abnormal Performance Index (API) was used in order to identify abnormal returns around the period of earnings announcements.

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\(^3\) One expectation model applied in accordance with net income and earnings per share (EPS) (variables 1 and 2 in figure 1) while another in accordance with EPS only (variable 3 in figure 1).

\(^4\) See figure 1.
Their results were consistent with a gradually increasing market reaction before the announcements, followed by weak price adjustment during the announcement month. Furthermore, the post-announcement drift, although evident for about 1 month following the announcements, was characterised by near-zero abnormal returns. They claimed that although the information content of accounting numbers is unquestionable, annual earnings should not be considered as a *timely* mean of information. Ball and Brown illustrated graphically these findings as follows:

![Figure 2. 'Abnormal Performance Indexes for Various Portfolios' (Source: Ball and Brown, 1968, p.169).](image)

Beaver (1968), who also examined NYSE during the same period, collected weekly data of the price changes and trading volume of stocks, and applied the *Market Model* in order to define the normal returns and find the residuals. Moreover, he claimed that in order to
identify the information content of earnings announcements, the changes in market’s expectations should be large enough so that they are able to provoke changes to the individual investors’ expectations, with the former changes being reflected in price tests while the latter in trading volume tests. The results revealed that considerable price and trading volume reaction took place during the announcement week with no significant reaction during the weeks following the announcements. Beaver reckoned that these findings were consistent with Ball and Brown’s results, at least with respect to the information content of annual earnings.

Based on these results, Ball and Brown’s findings should be inconsistent with strong form efficiency while Beaver’s findings seem consistent with semi-strong form efficiency, bearing in mind the market’s response on the announcement week. Since both authors do not provide us with complete certainty regarding market efficiency and based on the absence of profitable opportunities, one might suggest that NYSE was acting as near efficient.

Since Ball and Brown (1968) and Beaver’s (1968) studies were published, a considerable amount of researchers had attempted to investigate the earnings-returns relationship in the United States’ capital markets with respect to either annual or quarterly earnings announcements.

Beaver’s (1968) evidence was mainly supported by researches based on daily and intraday analysis, such as these of Morse (1981) and Patell and Wolfson (1984). Morse revealed significant price reaction on the announcement day while Patell and Wolfson found that

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5 Note that the term ‘near efficient’ was originally identified in Keane’s writings (Keane, 1983).
the largest part of the market’s reaction took place within 15 minutes. However, in contrast with Beaver, they revealed significant price reaction during the 3 days following the earnings announcements and for several hours following the announcements respectively (Morse, 1981; Patell and Wolfson, 1984).

Significant abnormal returns during the period following the earnings announcements were also identified by a considerable amount of researchers who replicated Ball and Brown’s methodology (Jones and Litzenberger, 1970; Joy et al., 1977; Brown, 1978). It should be mentioned that, although the majority of these studies applied the Market Model in order to define normal returns, an additional measure to API had been applied in order to trace abnormal performance, meaning the Cumulative Average Residual (CAR) approach which was introduced by Fama et al. (1969) and has been widely used until nowadays.

Ball (1978) examined the evidence of these previous studies and attributed the significant abnormal returns during the post-announcement period to inadequate estimations of the models applied and not to real market inefficiencies, providing also suggestions in order to reduce the bias, mainly caused by misspecification of the two-parameter model.

Nevertheless, Watts (1978), who considered the period 1962-1968 and attempted to trace abnormal returns during the weeks surrounding quarterly earnings announcements of firms listed on NYSE, found that the reported abnormal returns from 1962 to 1965 were too large to be explained by measurement errors as suggested by Ball. However, according to Watts, these opportunities were limited to those investors who were capable to avoid direct transaction costs, such as skilled brokers. Furthermore, he reported abnormal returns not statistically different from zero during the period 1965-1968.