

# **Price Adjustment Method and Ex-Dividend Day Returns in a Different Institutional Setting**

Panagiotis N. Asimakopoulos<sup>a</sup>

Nickolaos V. Tsangarakis<sup>b</sup>

Emmanuel D. Tsiridakis<sup>c</sup>

Corresponding Author: Emmanuel D. Tsiridakis,

e-mail: manolis@unipi.gr

tel: +30-210-4142187

<sup>a</sup>University of Piraeus, Department of Banking and Finance, e-mail: pasimako@unipi.gr

<sup>b</sup>University of Piraeus, Department of Business Administration, e-mail: ntsang@unipi.gr

<sup>c</sup>University of Piraeus, Department of Banking and Finance, e-mail: manolis@unipi.gr

# **Price Adjustment Method and Ex-Dividend Day Returns in a Different Institutional Setting\***

## **Abstract**

This study investigates the determinants of the ex-dividend day price behavior in the Athens Stock Exchange (ASE), a unique institutional setting, and examines how a major regulatory change in the price adjustment method affects the extent of the ex-day stock price drop. We find that allowing the market to freely adjust prices, after 2001, the ex-dividend day price improves the pricing efficiency of the market in the sense that the raw price ratio tends to one and abnormal returns tend to zero. We also find that in the absence of taxes on dividends and capital gains and certain microstructure impediments discussed in the literature –i.e., bid-ask spread, market makers, price discreteness, tick size and limit order adjustment mechanism–stock illiquidity is the best candidate for explaining the magnitude of the ex-dividend day price adjustment.

Key words: Ex-dividend day, microstructure, illiquidity, regulation change, ASE

JEL Classification: G14, G35, G38.

\* The authors are grateful to the editor Brian Lucey and to an anonymous reviewer for their constructive comments and insightful suggestions. We also thank A. A. Antzoulatos.

# Price Adjustment Method and Ex-Dividend Day Returns in a Different Institutional Setting

## 1. Introduction

According to standard financial theory, the share price on the ex-dividend day should fall by an amount exactly equivalent to the dividend paid on each share. However, empirical results show that, on average, stock prices drop by less than the dividend amount distributed. Studies have proposed several explanations for the unequal price drop. These include the existence of tax-induced clienteles (when the tax rate applicable to income from capital gains is lower than that from dividends).<sup>1</sup> Other studies challenge the tax effect and propose the short-term trading hypothesis according to which transaction costs and risk affect ex-day prices and volume behavior.<sup>2</sup> Additionally, other researchers have proposed market microstructure explanations, arguing that the ex-dividend day price drop is strongly affected by the bid-ask spread (nuisance of handling dividends), price discreteness of stock prices due to minimum tick sizes, absence of electronic settlement systems, and other behavioral biases.<sup>3</sup>

One way to further clarify our understanding is to study the ex-dividend day price behavior in an environment where the above factors are either absent or limited. Such are the markets of Hong Kong, and Oman, where both dividends and capital gains are not taxed, thus offering the opportunity to study the ex-dividend day returns in the absence of confounding tax effects present in other markets. The Hong Kong stock exchange (HKSE) provides such an institutional setting. Frank and Jagannathan (1998) examine the period 1980-1993 and find that the average price drop on the ex-day is only 43% of the dividend, leading to an ex-day return of 1.33%, their main explanation refers to market microstructure and bid-ask bounce; Kadapakkam (2000) also examines the HKSE for the period 1990-1995, following the launch of an electronic settlement system, and finds that the ex-dividend day returns declined to an insignificant 17% and concludes that “overall, the evidence supports the argument that regulatory or institutional features that inhibit short-term trading will adversely affect pricing efficiency of financial markets”. Al-Yahyaee et al. (2008) investigate the Oman Stock Exchange, where taxes are also absent for the period 1997-2005. Results show that ex-day stock prices fall by significantly less than the dividend amount with the price drop ranging between 65% and 69%.

---

<sup>1</sup> See Elton and Gruber (1970), Michaely and Murgia (1995), Green and Rydqvist (1999), Bell and Jenkinson (2002), Milonas et al. (2006), Graham et al. (2003), Elton et al. (2005) and Dhalival and Li (2006).

<sup>2</sup> See Kalay (1982), Lakonishok and Vermaelen (1986), Heath and Jarrow (1988), Kaproff and Walking (1988, 1990), Grammatikos (1989), Boyd and Jagannathan (1994) and Michaely and Vila (1995, 1996).

<sup>3</sup> See Shefrin and Statman (1984), Dubofsky (1992), Frank and Jagannathan (1998), Bali and Hite (1998), Kadapakkam (2000), Jakob and Ma (2004), Al-Yahyaee et al. (2008).

Their main market microstructure explanation refers to the bid-ask spread, which is consistent with Frank and Jagannathan (1998).

The Athens Stock Exchange (ASE) offers an even more unique institutional setting to study ex-dividend day stock price behavior. Besides dividends and capital gains being tax free, dividends are annual, mandatory and the transaction costs are low.<sup>4</sup> Also, significant market microstructure impediments observed in other developed stock markets (i.e., bid-ask spread, market makers, price discreteness, tick size and limit order adjustment mechanism) are not present in the ASE. Specific institutional characteristics of the ASE, analyzed in the following section, allow us to exclude the respective explanations presented for the ex-dividend day stock price anomaly, that is, the bid-ask spread and market maker hypothesis (Frank and Jagannathan (1998)), the price discreteness and tick size hypothesis (Bali and Hite (1998)) and the limit order adjustment mechanism hypothesis (Dubofsky (1992)).

Milonas and Travlos (2001) examine stock price behavior on the ex-dividend day in the ASE for the period 1994-1999. Their findings show that on the ex-dividend day, stock prices fall less than the dividend paid (43%). They argue that their results cannot be attributed to tax effects and that the particular microstructure effects identified by prior studies are not the determining factors. Dasilas (2009) examines the ex-dividend price and trading volume behavior in ASE during the period 2000-2004 and finds that stock prices drop less than the dividend and the mean raw price ratio (87%). The main explanation he proposes is short-term trading (short-term traders contribute to the efficiency of financial markets by constantly searching the markets for arbitrage opportunities).

Thus, although the price drop is well established as an empirical regularity, for US and non-US stock markets, the explanations offered for the observed anomalous ex-day price behavior reveal that there is a lack of unanimity in the conclusions and that it is still very much an unresolved issue making further research potentially useful.

The aim of this study is: (a) To examine how the introduction of a new regulation may affect the ex-dividend day stock price behavior in a market with a unique institutional setting (no dividend

---

<sup>4</sup> During the period studied, according to corporate Law 2190/1920, profitable firms are required to distribute a minimum dividend equal to either 6% of their outstanding share capital or 35% of net profits after tax, whichever of the two amounts is larger. Shareholders are not subject to any taxes on dividends received or capital gains realized. This makes investors indifferent to the source of their returns. (Today firms are obligated to distribute as dividends only at least 35% of their profits after tax. Also, see Castillo and Jakob (2006) for mandatory dividend distributions in Chile). Commission costs in the ASE were deregulated in 1996; since then, brokerage fees are set freely, but not above a maximum percentage of 1% set by the Association of Securities Firms. The suggested fee structure is scaled down to a maximum fee of 0.50% for transactions larger than €8,800. However, large transactions by institutional investors are subject to even smaller fees of around 0.10% to 0.20%. Also, after March 1998, a 0.30% flat sales tax was imposed on the proceeds from stock sales. In late 1999 it increased to 0.60% and in 2001 it fell again to 0.30%.

and capital gain taxes) and to test the hypothesis that market pricing improves after the introduction of the new ex-dividend day price adjustment method (this is the first study to consider the effect of the adjustment method on the ex-day returns, comparing returns for the period “*before*” and “*after*” the change of the institutional setting); (b) to identify possible determinant factors explaining the ex-dividend day stock price drop; and (c) to re-examine the ex-dividend day behavior in the ASE using an extended sample period (1996-2005), updating earlier research.

Until the first quarter of 2001 the opening stock price on the ex-dividend day ( $P_0$ ) was calculated automatically by the ASE before the opening of the market as the difference between the share price on the last cum-dividend day ( $P_{-1}$ ) (closing price on the day prior to the ex-dividend day) minus the dividend per share paid ( $D$ ), ( $P_0 = P_{-1} - D$ ).<sup>5</sup> However, starting April 2, 2001, the board of directors of the ASE approved to end the automatic adjustment of the opening stock price on the ex-dividend day (Law published in the Gov. Gaz. 355B/30-3-2001). Now the opening share price on the ex-dividend day ( $P_0$ ) is set equal to the share’s price on the last cum-dividend day ( $P_{-1}$ ), i.e.,  $P_0 = P_{-1}$  and trading orders given by investors determine the degree of the price adjustment and naturally the closing price on the ex-day. The new mechanism transfers the adjustment of the ex-day price to knowledgeable professionals and investors. Thus, we may expect the raw price ratio to increase compared to the previous period (“*before*”), which may be considered an indication of improvement in market pricing efficiency.

We find that the introduction of the new institutional feature —the change of the ex-day price adjustment method— increased the raw price ratio on the ex-dividend day from 37% to 62% and the abnormal returns decreased from 2.26% to 1.18%, all statistically significant. Also, abnormal volume remains similarly significant in both periods (“*before*” and “*after*”); however, volume is slightly smaller with the new adjustment method. The cross sectional regression analysis of abnormal returns to several variables reveals no significant effect. In addition, evidence of a clientele preference of capital gains over dividends is not observed (there is no significant clear pattern between the relative price drop and dividend yields). Thus, it is not possible to infer the marginal investor’s income tax rate, which is a central part of the tax clientele hypothesis. Also, we find that illiquidity is the strongest candidate in explaining the magnitude of the ex-dividend day price adjustment (in the low illiquidity quartile (high liquidity) the price drop equals the dividend amount and the abnormal returns are close to zero).

---

<sup>5</sup> Even shares with no trading activity on the ex-dividend day are adjusted downward for the distributed dividend.

This study contributes to the international literature on ex-dividend day behavior in a tax-free environment in three ways. First, it offers evidence that allowing the free function of the market, by relaxing institutional intervention levels-out pricing inefficiencies. Second, it identifies share illiquidity (a proxy for the bid-ask spread) as the strongest impediment and proposes an explanation for the ex-dividend day price behavior in the ASE. Finally, it provides a better understanding of market pricing for academics as well as professionals interested in forming investment strategies in markets with similar and other institutional settings.

The remainder of the paper is organized as follows. Section 2 provides information concerning the institutional setting and market microstructure impediments of the ASE. Section 3 describes the data and the sample. Section 4 presents the tests, and interprets the results. Section 5 summarizes the paper.

## **2. Institutional Setting and Market Microstructure Impediments**

As previously noted, research covering other markets suggests that microstructure impediments (market features) may prevent the ex-dividend day stock price from dropping by an amount equal to the dividend paid, resulting in positive ex-day returns. However, in the ASE certain impediments are not present due to the different institutional setting (rules and procedures) that was in effect during the period investigated. In this section we present the market characteristics described in the literature as impediments for the ex-day price adjustment, which are not present in the Greek capital market, i.e., bid-ask spread, market makers, price discreteness, tick size, and limit order adjustment mechanism.

### *2.1. Bid-ask spread and market makers*

Frank and Jagannathan (1998) argue that, despite the absence of taxation in the Hong Kong stock exchange, stock prices drop on the ex-dividend day by half the amount of the dividend paid and has been attributed to the effect of the bid-asked spread. They suggest that for the average investor it is a burden to receive and reinvest dividends so they choose not to receive them, but this is not true for market makers. Thus, large traders/market-makers have a comparative cost advantage when collecting and reinvesting dividends, so they buy shares before a stock goes ex-dividend and resell them after the stock goes ex-dividend. Most of the trades occur at the bid price before the stock goes ex-dividend and at the ask price on the ex-dividend day. They argue that such a trading behavior may lead to a smaller price drop than the dividend paid (i.e., positive ex-day returns). They conclude that this bid-ask bounce contributes to the ex-dividend day behavior.

In the ASE, market-makers were first introduced in June of 2001 (Regulation 1/216/17-5-2001, Gov. Gaz. 667B/31-5-2001). It is optional for listed firms to appoint a market maker and must be approved by the ASE. During the period until 2005 market-makers were appointed only by 6 firms in our sample. Specifically a detailed search of the ASE data revealed that only 17 events out of the 500 events in our final sample had a market-maker appointed.<sup>6</sup> Furthermore, information concerning bid-ask spreads for this limited number of events were not available from the ASE. Nevertheless, during the period investigated, it is quite simple for the average investor to receive and reinvest the relatively high annual dividends in the ASE, also, dividends and capital gains are not taxed, thus, investors that may sell their shares before the ex-day do so for reasons other than those described by Frank and Jagannathan (1998). Therefore, in the ASE, any price drop on the ex-day cannot be attributed to bid-ask spreads and market-makers.

## 2.2. Price discreteness and tick size

Bali and Hite (1998) investigating stocks traded in the New York (NYSE) and American (AMEX) Stock Exchanges, offer an alternative explanation of the ex-dividend day stock price behavior that does not involve tax effects. They argue that the ex-dividend day price drop is restricted by tick size. To the extent that the market systematically rounds the dividend down to the nearest tick, the ex-dividend price drop will be less than the amount of the dividend implying a positive abnormal return on the ex-day. Although this explanation is valid for stock exchanges with small ticks and small quarterly dividends like the NYSE, it cannot explain the stock price drop on the ex-dividend day in stock exchanges where there are large annual dividends and small ticks, e.g., the Athens and Oman stock exchanges. On the other hand, Graham et al. (2003) and Jakob and Ma (2004) argue that tick size restrictions do not explain ex-day returns, and Kadapakkam and Martinez (2008) also suggest that the tick size effect is not applicable in countries where stock prices are decimalized.

Stock prices on the ASE are decimalized, thus, price discreteness is less of a problem in the ASE. Also, tick sizes are very small (compared to the dividends) and depend on the level of the stock price and have been set at €0.01 for stock with closing prices between €0-€2.99, €0.02 for stock with closing prices between €3.00-€9.99 and €0.05 for stock with closing prices above €10.00.<sup>7</sup> While in

---

<sup>6</sup> One firm had a market maker assigned during the four-year period from 2002 to 2005 (4 events), three firms had market makers for the three-year period from 2003 to 2005 (9 events), and two firms had market makers for the two years 2004 and 2005 (4 events), thus, a total of 17 events. (Source of data: Press Release of the Athens Exchange Board of Directors, (<http://www.ase.gr/content/en/Announcements/ASEPress/BOD/>)).

<sup>7</sup> Source, Athens Stock Exchange Fact Book (2002). Also, note that during the period investigated stocks trading above €9.99 were uncommon.

many countries (e.g., United States and United Kingdom) dividends are paid quarterly or semi-annually, in the ASE dividends are mandatory and paid annually after the regular Annual Shareholders Meeting, usually between April and July. This lowers the significance of a small tick size as an important factor of the ex-day price behavior on the ASE. Thus, any price drop smaller than the dividend and any positive abnormal return on the ex-day should be attributed to factors other than the tick size.

### *2.3. Limit order adjustment mechanism*

Another market microstructure characteristic proposed as an explanation of the positive ex-dividend day abnormal returns is based on the limit order adjustment model derived by Dubofsky (1992). He provides evidence that ex-dividend day abnormal returns are a result of the mechanics of NYSE Rule 118. According to this rule, all limit buy orders existing on the ex-day are reduced by the dividend amount, and if the resulting price is not a multiple of a tick, the limit buy price is further reduced to the next tick resulting in positive ex-dividend day abnormal returns. All limit sell orders existing on the ex-day are not adjusted. Thus Dubofsky's (1992) findings support the hypothesis that the market mechanism inhibits the ex-dividend day price drop.

In the ASE limit orders were introduced in 1999 with the new electronic trading system of the ASE (Regulation No 18/ 15-1-1999, Gov. Gaz. 40B/27-1-1999).<sup>8</sup> However there is no adjustment mechanism that may affect the price drop on the ex-dividend day as described by Dubofsky (1992). Also, as already mentioned, from April 2, 2001 (Gov. Gaz. 355B/30-3-2001) the ASE ended the automatic adjustment of the opening stock price on the ex-dividend day ( $P_0$ ), the ex-day price is now set equal to the share's price on the last cum-dividend day ( $P_{-1}$ ). Thus any degree of price adjustment observed is a result of investors submitting new orders on the ex-dividend day. If they choose to fully adjust their new order submissions by the dividend paid we should observe a price drop equal to the dividend in the ASE. Conversely, if investors do not fully adjust their orders, this lack of full adjustment can no longer be blamed on the automatic electronic system operated by the exchange. It is, therefore, interesting to examine the price drop in a regime such as that of the Greek capital market.

Thus, the different institutional setting of the ASE removes the above microstructure explanations proposed for the dividend puzzle and creates a unique test environment that offers the

---

<sup>8</sup> Note that the ASE is an electronic order driven market. During the trading session, the electronic system is based on the matching of orders according to price and time priorities. Only ASE members can execute purchase and sale orders for shares through the Integrated Automatic Electronic Trading System (OASIS) of the market.

opportunity to refocus on other potential explanatory factors of the ex-dividend day stock price behavior.

### **3. Data and Sample**

The period investigated includes the years from 1996 to 2005. All stocks traded in the ASE during this period were candidates for selection. In order for a firm's stock to be included in the final sample it must meet simultaneously all the following criteria: 1) stocks must have paid only cash dividends every year of the period investigated (1996-2005); 2) ex-dividend dates must be publicly available; 3) stocks must be continuously traded (they are not under supervision) during the period investigated; 4) stock prices as well as trade volumes must be available in the  $t = -150, t = +150$  window around the ex-dividend day ( $t = 0$ ); 5) no stock splits, stock dividends, or equity issues have occurred in the same time window. There are 50 listed firms that meet the above criteria and, thus, a total of 500 ex-days are analyzed in this study (50 annual dividends for a ten year period). Data collected include: ex-dividend dates for the period 1996-2005, dividends, stock prices and prices of the ASE index in the respective time period for each ex-dividend day of every stock and number of shares traded on each day for each company for the period 1996-2005. Sources of the data collected include the ASE and the DataStream database.

The 500 ex-days included in the sample are divided into two groups of equal size. The 250 ex-days occur during the period “*before*” the change of the ex-dividend day price adjustment method (from 1996 to 2000), the period of the automatic adjustment of the ex-day prices by the ASE. The remaining 250 ex-days occur during the period “*after*” the change of the ex-dividend day price adjustment method (from 2001 to 2005), the period during which the adjustment of ex-day prices is implemented by investors through market trading.

### **4. Tests and Results**

#### *4.1. Price behavior on the ex-dividend day*

In order to detect the presence of the ex-dividend day puzzle in the ASE, we measure the magnitude and sign of the stock price behavior on the ex-day in relation to the stock price on the last cum-dividend day for the periods “*before*” and “*after*” the change of the ex-dividend day share price adjustment method, using the methodology employed by Michaely (1991), Milonas and Travlos (2001), Graham et al. (2003) and Al-Yahyae et al. (2008).

Based on Elton and Gruber's (1970) model, that establishes a relationship between stock price behavior on the ex-day and taxes, a shareholder who holds one share on the last cum-dividend day ( $P_{-1}$ ) will observe a price drop on the ex-dividend day ( $P_0$ ). They find that, because dividends are taxed, the stock price on average will drop by an amount less than the dividend paid. More specifically the stock price will drop by the net dividend amount (the amount remaining to stockholders after taxes are paid). They argue that the positive ex-day return is due to a higher tax on dividends compared to capital gains. Several studies agree with Elton and Gruber's findings, while others disagree that the ex-dividend day price drop can be attributed to tax effects (Kalay (1982), Graham (2003)).

However, in the ASE, where dividends and capital gains are not taxed, a shareholder's wealth will be the sum of the share price on the ex-day ( $P_0$ ) plus the amount of the cash dividend ( $D$ ) he is entitled to receive. To prevent arbitrage, this value should not be different from the share price that a seller has received on the last cum-dividend day ( $P_{-1}$ ), *ceteris paribus*:

$$P_{-1} = P_0 + D \quad (1)$$

By subtracting  $P_0$  from both sides of the equation and dividing by  $D$ , we obtain the raw price ratio (RPR):

$$RPR = \frac{P_{-1} - P_0}{D} = \frac{P_0 + D - P_0}{D} = 1 \quad (2)$$

Equation (2) describes the price change from the last cum-dividend day to the ex-dividend day in terms of the dividend paid. The theoretical value of RPR is 1, the price drops by the exact amount of the dividend. Because the RPR is subject to market influences between the two days we also provide a market-adjusted price ratio (MAPR) by discounting the price on the ex-dividend day by the daily market return ( $R_m$ ):

$$MAPR = \frac{P_{-1} - \frac{P_0}{1 + R_m}}{D} \quad (3)$$

where,  $R_m$  is the return on the market index, approximated by the corresponding Athens stock exchange index. As in the case of RPR, the theoretical value of MAPR is also 1.

Several studies, suggest that the traditional ratio RPR (2) suffers from heteroskedasticity and independence. Heteroskedasticity arises because the ratio is scaled by the dividend amount, which means that the weight given to changes in observations where dividends are low is excessive (Eades et al. (1984), Barclay (1987), Michaely (1991), Boyd and Jagannathan (1994), and Bell and Jenkinson

(2002)). Thus, we calculate the raw price drop ratio (RPDR) –the price difference depicted in Equation (2) expressed in terms of the price on the last cum-dividend day.

$$RPDR = \frac{P_{-1} - P_0}{P_{-1}} = \frac{D}{P_{-1}} \quad (4)$$

As shown in the right hand side of equation (4), RPDR on the ex-dividend day has a theoretical value equal to the dividend yield (denoted below). As before, we can also calculate the market-adjusted price drop ratio (MAPDR) as follows:

$$MAPDR = \frac{P_{-1} - \frac{P_0}{1 + R_m}}{P_{-1}} \quad (5)$$

The theoretical value of MAPDR equals the dividend yield (denoted below), similar to RPDR. The dividend yield (DY) is computed as the dividend per share (D) divided by the stock price on the last cum-dividend day ( $P_{-1}$ ).

$$DY = \frac{D}{P_{-1}} \quad (6)$$

Note that in order to measure the theoretical values we assume that the ex-dividend day price drops are equal to the dividends paid. Equations (2) and (3) receive a theoretical value equal to 1, while equations (4) and (5) receive a theoretical value equal to the dividend yield. Thus, differences between observed and theoretical values (measured with equations (2), (3), (4) and (5)) indicate that the dividend puzzle is present in the ASE.

Table 1 presents the stock price behavior on the ex-day for the periods “*before*” and “*after*” the change of the ex-dividend day share price adjustment method. We calculate both theoretical and observed values (mean and median) for the following ratios: raw price ratio (RPR), market-adjusted price ratio (MAPR), raw price drop ratio (RPDR), and market-adjusted price drop ratio (MAPDR). The observed mean and median values of the dividend yield (DY) are also reported. The differences of the means from their corresponding theoretical values are tested using t-tests and the corresponding t-statistics are shown in parentheses. Furthermore, we use the Wilcoxon signed rank test to examine the difference of the medians from the corresponding theoretical values and the corresponding p-values are shown in parentheses.

There are two panels in Table 1. Panel A refers to the sample of dividend distributions “*before*” the change of the ex-dividend day price adjustment method, i.e., the period from 1996 to 2000, and Panel B refers to the sample of dividend distributions “*after*”, i.e., the period from 2001 to 2005, during

which the ex-dividend day price was adjusted with the new method. We do this to observe the effect of the institutional change. The launch of the new adjustment method in the ASE is expected to reduce if not eliminate the difference between the dividend paid and the price drop.

**Please insert Table 1 here**

As shown in Panel A of Table 1, for the period “*before*” the change of the ex-dividend day price adjustment method (from 1996 to 2000), the mean (median) RPR for the sample of dividend distributions is 0.3660 (0.5815). The corresponding t-statistic (p-value) is  $-2.7556$  (0.0000), suggesting that the difference of the mean (median) from the corresponding theoretical value of 1.0000 (1.0000) is statistically significant at the 1% level of significance. The mean (median) MARPR is 0.5051 (0.5928) with corresponding t-statistic (p-value) of  $-2.2110$  (0.0000), statistically significant at the 5% level of significance. The stock price behavior on the ex-dividend day can also be analyzed by comparing the RPDR and the MAPDR with their corresponding theoretical values. The mean (median) RPDR is 0.0163 (0.0164) with corresponding t-statistic (p-value) of  $-5.8737$  (0.0026), statistically significant at the 1% level of significance. The mean (median) MAPDR is 0.0165 (0.0159) with corresponding t-statistic (p-value) of  $-6.0914$  (0.0020), statistically significant at the 1% level of significance. Finally, the mean (median) DY is 0.0391 (0.0237) with corresponding t-statistic (p-value) of  $13.7017$  (0.0000), statistically significant at the 1% level of significance. The evidence shows that on the ex-dividend day, the stock price declines by an amount that is less than the dividend paid. Our findings confirm previous results from other markets where neither dividends nor capital gains are taxable (Frank and Jagannathan (1998) and Kadapakkam (2000) for Hong Kong, Al-Yahyaee (2008) for Oman and Milonas and Travlos (2001) and Dasilas (2009) for Greece). Also, our results are consistent with evidence from countries where dividends are taxed heavier than capital gains.<sup>9</sup>

In Panel B of Table 1, for the sample of dividend distributions “*after*” the change of the ex-dividend day price adjustment method, period 2001-2005, the mean (median) RPR is 0.6233 (0.7290). The corresponding t-statistic (p-value) is  $-3.7868$  (0.0000), suggesting that the difference of the mean (median) from the corresponding theoretical value of 1.00 (1.0000) is statistically significant at the 1%

---

<sup>9</sup> The findings are in line with evidence reported by: Grammatikos (1989) for the period after the 1984 tax reform, Michaely (1991) for the period from April 1986 to March 1987 (this period is before the implementation of the 1986 Tax Reform Act that aligned the tax treatment of dividend income and capital gains) and Bali and Hite (1998). On the other hand, the evidence is inconsistent with the findings provided by Green and Rydqvist (1999) on the ex-dividend day (the stock price was higher than the price on the cum-day for a sample of Swedish lottery bonds which operate in an environment with barriers for short-term arbitrage and with cash distributions from such bonds enjoying a tax advantage relative to capital gains).

level of significance. The mean (median) MAPR is 0.5721 (0.7037) with corresponding t-statistic (p-value) of -4.0181 (0.0000), statistically significant at the 1% level of significance. The mean (median) RPDR declined to 0.0209 (0.0230) with corresponding t-statistic (p-value) of -4.8135 (0.0009), statistically significant at the 1% level of significance. The mean (median) MAPDR is 0.0199 (0.0195) with corresponding t-statistic (p-value) of -5.5263 (0.0000), statistically significant at the 1% level of significance. Finally, the mean (median) DY is 0.0316 (0.0280) with corresponding t-statistic (p-value) of 28.0761 (0.0000), statistically significant at the 1% level of significance. Again, the evidence shows that on the ex-dividend day, the stock price declines by an amount that is less than the dividend paid. However, we observe that after the change of the ex-dividend day price adjustment method, (“*after*” period), the raw price ratio and other ratios are larger than those of Panel A, indicating that there may be a pricing improvement. Nevertheless, we observe that stock prices drop by less than the amount of the dividend in both periods (“*before*” and “*after*”) confirming results of previous studies of the ASE (Travlos (2001) and Dasilas (2009)), hence, the ex-dividend day puzzle is present in the Greek market.

#### 4.2. *Ex-divided day abnormal returns*

Institutional changes may shape investor’s trading behavior “*after*” their introduction, and affect stock returns on the ex-day that may inhibit reduction of the ex-dividend day price. We use the market-adjusted returns model to estimate daily and cumulative abnormal returns (CARs).<sup>10</sup> The ASE General Index is used to calculate the market returns.

Table 2, in upper part, reports average abnormal returns (ARs) for event days -5 to +5 around the ex-dividend day ( $t=0$ ), over the periods “*before*” (1996 to 2000) and “*after*” (2001 to 2005) the change of the ex-dividend day price adjustment method, differences between ARs ( $DAR = AR_A - AR_B$ ) and respective tests of significance. The lower part of Table 2 displays cumulative abnormal returns (CARs) for event periods (-5, -1), (-2, -1), (+1, +2), and (+1, +5), differences between CARs ( $DCAR = CAR_A - CAR_B$ ) and associated t-statistics.

#### **Please insert Table 2 here**

From Table 2, during the period “*before*” the change of the ex-dividend day price adjustment method, the average abnormal return on the ex-dividend day is 2.2572%, which is highly significant at

---

<sup>10</sup> Similar results were obtained when we used the mean adjusted returns model, and the market model. These results are available upon request.

the 1% level of significance (t-statistic= 10.9671). Also, we find statistically significant abnormal returns on day -1 (0.4837%), significant at the 5% level of significance (t-statistic= 2.3500). The positive returns prior to the ex-day may be due to increased buying by investors interested in dividends. For the period “*after*” the change of the adjustment method the average abnormal return on the ex-dividend day drops to 1.1790%, statistically significant at the 1% level (t-statistic= 5.7881), while, on the other event days abnormal returns are statistically insignificant at all the conventional levels of significance. On the announcement day (t=0) the difference between ARs, DAR= -1.0782, is statistically significant at the 1% level (t-statistic= -3.1867).

CARs during the period “*before*” are statistically significant and positive for event periods (-5, -1) at the 1% level (CAR<sub>B</sub>= 1.4843, t-statistic= 3.2253), and (-2, -1) at the 5% level (CAR<sub>B</sub>= 0.6940, t-statistic= 2.3844). During the period “*after*”, CARs are statistically insignificant at all selected event periods. The differences between CARs, (DCARs), is statistically significant and negative, only for event period (-5, -1) at the 1% (DCAR= -0.9353%, t-statistic= -3.1530).

Thus, the institutional change results in statistically significant lower abnormal returns on the ex-day which may be considered an indication that pricing of financial markets is improving. Also, the insignificant CARs (for periods (+1, +2) and (+1, +5)) may be a sign that there is no trading pressure, further strengthening the indication that pricing efficiency improved on the ex-day

#### 4.3. Cross-sectional test

We provide additional evidence on ex-day abnormal returns (AR) by investigating the likelihood that short-term trading, transaction costs, risk and the adjustment method may inhibit arbitrage through a cross section regression analysis, which captures the potential impact of several variables on the abnormal return. Our cross sectional model regresses abnormal returns against the independent variables for dividend yield, transaction cost, risk, and adjustment method, used by Kadapakkam and Martinez (2008) and Al-Yahyae et al. (2008). The regression model is as follows:

$$AR_i = a_0 + a_1 DY_i + a_2 (1/P_{cumi}) + a_3 (\sigma_{ei} / \sigma_{mi}) + a_4 AM + e_i$$

where:

AR<sub>i</sub> : is the abnormal return as estimated previously in section 4.2.

DY<sub>i</sub> : is the dividend yield for stock i as estimated previously in section 4.1.

1/P<sub>cumi</sub> : is the inverse of stock i's closing price on the last cum-dividend (P<sub>cum</sub>) day as a proxy for transaction costs.

$\sigma_{ei} / \sigma_{mi}$  : is the standard deviation of the residuals from estimating the market model, normalized by market risk (a proxy for idiosyncratic risk).

AM : is a dummy variable for the ex-dividend day price adjustment method, which takes on a value of zero (0) for the period “*before*” the new adjustment method (1996-2000) and one (1) for the period “*after*” (2001-2005).

The dividend yield (DY) is measured as the ratio of the dividend paid (D) to the share price on the last cum-dividend day ( $P_{cum}$ ). Lakonishok and Vermaelen (1986) and Kaproff and Walkling (1988) argue that higher-yield stocks will attract more short-term trading, because the net benefits of the dividend capture are larger. To the extent it occurs, short-term trading will concentrate among high-yield stocks. They find that profitability of short-term trading is an increasing function of dividend yield. This implies a positive association between ex-day abnormal returns and dividend yield that signals short-term trading.

Kalay (1982) argues that stock prices should drop by an amount equal to the dividend. If this is not true, short-term traders may earn excess returns. However transaction costs may inhibit their ability to earn arbitrage profits. Thus the level of transaction costs may function as a barrier for short-term trading in the period around the ex-dividend day, which reduces volume of trade and ex-dividend day premium. Kaproff and Walkling (1988, 1990) find that ex-day returns are higher for higher-yield stocks with higher trading costs. Also, Naranjo et al. (2000) report evidence of a positive association between ex-day abnormal returns and transaction costs which is considered evidence of short-term trading around the ex-day to capture dividends. Consequently, if dividend capture occurs, the resulting ex-day abnormal returns are expected to be positively correlated with the cost of trading.

As proposed by Karpoff and Walkling (1988), Naranjo et al. (2000) and Dhaliwal and Li (2006) we employ the inverse of the closing stock price on the last cum-day  $P_{cum}$  ( $1/P_{cum}$ ) as a proxy for transaction costs.<sup>11</sup> These studies argue that a share with a higher level of  $1/P_{cum}$  results in higher percentage brokerage costs that may prevent dividend capture. Furthermore, Bhardwaj and Brooks (1992) find evidence that round-trip commissions are inversely related to share prices. Thus, if short-term traders capture dividends and given that firms with higher  $1/P_{cum}$  ratios are more likely to have higher trading costs, we should expect a positive relationship between ex-day abnormal returns and the transaction cost proxy ( $1/P_{cum}$ ).

Heath and Jarrow (1988) find that ex-dividend day stock prices are unknown, making it difficult for short-term traders to generate riskless arbitrage profits. Thus, since short-term trading is constrained

---

<sup>11</sup> Other studies that apply  $1/P_{cum}$  as a proxy for transaction costs are: Cloyd et al. (2006), AlYahyae et al. (2008) and Kadapakkam and Martinez (2008).

by risk, ex-dividend returns must include a risk premium because ex-day share prices are unknown.<sup>12</sup> To test this affect, we use a risk measure similar to that used by Michaely and Vila (1996), Cloyd et al. (2006) and Al-Yahyae et al. (2008). Risk is measured as the standard deviation of the residuals from a market model regression of daily returns for the dividend paying stocks on daily market returns, divided by the standard deviation of daily market returns ( $\sigma_{ei} / \sigma_{mi}$ ). Since a short-term trader has to be compensated for taking extra risk, we expect a positive relationship between the ex-day abnormal returns and our risk proxy.

Finally, there is a dummy variable for the ex-dividend day price adjustment method (AM) which takes on a value of zero (0) for the period “*before*” the new adjustment method (1996-2000) and one (1) for the period “*after*” (2001-2005). We examine whether abnormal returns are affected by the institutional change of the ex-day price adjustment process. A negative value on this variable, would suggest that abnormal returns are lower after the enforcement, that is, the ex-day pricing anomaly improves.

Results are reported in Table 3. The coefficient of the dividend yield variable is positive (0.6176) and statistically significant at the 1% level of significance (t-statistic= 13.0690), suggesting that companies that have high-dividend yield stocks (which are most likely to attract potential arbitrageurs) have their shares negotiated at higher prices on the ex-dividend day. This positive relationship is a sign of short-term trading hypothesis and is consistent with predictions of other studies (e.g., Frank and Jagannathan (1998), Kadapakkam and Martinez (2008) and Dasillas (2009)) and rejects the tax hypothesis.

### **Please insert Table 3 here**

On the other hand, both coefficients of the variables for the transaction cost and risk are statistically insignificant at any conventional level of significance and do not affect abnormal returns on the ex-dividend day and may not prevent arbitrage activity. These findings indicate that neither transaction costs nor risk affect abnormal returns on the ex-dividend day and may not prevent arbitrage activity. Our results do not corroborate those of Dasillas (2009).

The coefficient of the dummy variable for the ex-dividend day price adjustment method is negative (-0.0060) and statistically significant at the 10% level of significance (t-statistic= -2.0824).

---

<sup>12</sup> For empirical evidence supporting the existence of a risk premium also see Grammatikos (1989), Boyd and Jagannathan (1994) and Michaely and Vila (1996).

The negative relationship supports previous findings that abnormal returns are reduced “*after*” the introduction of the new ex-dividend day price adjustment method in the ASE and confirms the contraction of the ex-day price anomaly.

#### 4.4. Trading volume analysis test

To test whether the change of the ex-dividend day price adjustment method is a source of friction that effects short-term trading activity around the ex-day and thus inhibits a proper price adjustment, we analyze the volume of trade for the periods “*before*” (1996-2000) and “*after*” (2001-2005) the institutional change. Abnormal trading volume (AV) is examined over the 11-day period centered on the ex-dividend day ( $t=0$ ) and is measured as follows:<sup>13</sup>

$$AV_{it} = V_{it} - NV_i$$

where:

$V_{it}$  : is the trading volume on day  $t$  of stock  $i$ , and

$NV_i$  : is the normal average volume of company  $i$  estimated over the period +11 to +111 (100 days) relative to the ex-dividend day ( $t=0$ )

Abnormal volume is defined as the deviation from the normal average daily volume during the control period. Standardized abnormal volume is calculated by dividing abnormal volume by the standard deviation of volume during the control period defined as days +11 to +111 relative to the ex-day. We test the statistical significance of trading volume around the ex-dividend day. If there is short-term trading then we should also observe statistical significant trading volume on these days.

Table 4, reports abnormal volume (AV) around the ex-dividend day ( $t=0$ ), cumulative abnormal volumes (CAVs) for the intervals (-1, 0), (-5, 0) and (+1, +5) and the respective t-statistics for the periods “*before*” (1996-2000) and “*after*” (2001-2005) the change of the ex-dividend day price adjustment method. Also, we show the differences between AVs ( $DAV = AV_A - AV_B$ ) and CAVs ( $DCAV = CAV_A - CAV_B$ ) with the respective tests of significance.

**Please insert Table 4 here**

---

<sup>13</sup> Lakonishok and Vermaelen (1986), argue that the influence of short-term traders around the ex-day can best be investigated by examining abnormal volume around the ex-day. The presence of short-term traders would be shown through positive abnormal volume around the ex-day. Green's (1980) analysis suggests that this abnormal trading volume will be highest on the cum-day and ex-day. There are many studies that report abnormal trading volume around the ex-days.

For the period “*before*” we observe positive AVs on the ex-day (t=0), statistically significant at the 10% level of significance (t-statistic= 1.9179). Also, AVs are statistically significant at higher levels of significance on most of the days preceding the ex-day. For the period “*after*”, similarly, we observe AVs on the ex-day (t=0), statistically significant at the 10% level of significance (t-statistic= 1.8275). Again, on most of the days preceding the ex-day, AVs are statistically significant at lower levels of significance. On the other hand, for both periods (“*before*” and “*after*”), AV becomes insignificant after the ex-day.

The AV prior to the ex-dividend day suggests that some shareholders believe that the difference between the prices cum-dividend and ex-dividend is greater than the amount of the dividend (Koski and Scruggs (1998)). The statistically insignificant AV after the ex-day may challenge the presence of short-term trading. When we calculate the differences between AVs (DAVs) we observe statistically insignificant DAVs in all event days, thus, the institutional change had no effect on investors trading behavior.

Cumulative abnormal volumes (CAVs) during the period “*before*” are positive statistically significant for the event periods (-1, 0) and (-5, 0) at the 5% level (t-statistic= 2.5509) and 1% (t-statistic= 3.6778) level of significance respectively and the CAV for the period (+1, +5) is statistically insignificant. During the period “*after*” there is a significant decrease in the CAV during the event periods before the ex-day, (-1, 0) and (-5, 0) consistent with investors acquiring less stock ahead of the ex-day. For the period after the ex-day (+1, +5) CAV is statistically insignificant at all conventional levels. The differences between CAVs, DCAVs, are statistically significant and negative, for event periods (-1, 0) and (-5, 0) at the 5% and 10% levels respectively (t-statistics= 2.4324 and 1.8381 respectively). Thus, after the institutional change results show that short-term trading may be becoming weaker.<sup>14</sup>

---

<sup>14</sup> To further investigate the possible presence of short-term trading we perform a cross sectional regression of the average abnormal volumes (AAV) around the ex-day (event days -1, 0) on the variables, dividend yield, transaction costs, risk, and the adjustment method. The table below presents regression results. We observe that there is no statistical significant relation between AAV, risk and transaction costs. These findings further clarify that there is no short-term trading and support the abnormal returns analysis results presented in Table 2.

$AAV_i = a_0 + a_1 DY_i + a_2 (1/P_{cumi}) + a_3 (\sigma_{ei} / \sigma_{mi}) + a_4 AM + e_i$					
<b><math>a_0</math></b>	<b><math>DY_i</math></b>	<b><math>1/P_{cumi}</math></b>	<b><math>\sigma_{ei} / \sigma_{mi}</math></b>	<b>AM</b>	<b>Adjusted <math>R^2</math></b>
1.0510 (2.5090)**	3.0861 (0.6108)	-0.4568 (-1.1105)	-0.1729 (-0.7370)	-0.4110 (-1.3515)	0.0112

The independent variables are:

$DY_i$ : is the dividend yield for a stock  $i$  measured as the ratio  $D / P_{-1}$

$1/P_{cumi}$ : is the inverse of stock  $i$ ’s closing price on the last cum-dividend day ( $P_{cum}$ ) as a proxy for the transaction costs.

#### 4.5. Relationship between dividend yields and abnormal returns

Previous researchers have documented that higher dividend yield stocks have higher raw price ratios (Grammatikos (1989), Michaely (1991) and Frank and Jagannathan (1998)). One explanation offered is that there is a clientele effect, where high (low) yield stocks are held by investors in lower (higher) tax brackets. Others believe that a smaller ex-day raw price ratio for low dividend yield stocks may result from the fact that these stocks may be ignored by traders due to relatively high transaction costs. By contrast, the institutional setting in Greece suggests that there is no clientele effect in the ASE where dividends and capital gains are not taxed. Since this is true, the significant positive relationship between dividend yields and price drop to dividend ratios should not be observed in the ASE data as in other markets.

To investigate the relationship between dividend yields, abnormal returns and raw price ratios in the ASE and the possible effects from the introduction of the ex-dividend day price adjustment method we sort the total sample and divide it into five Groups of shares of equal size based on the dividend yield (DY). In Table 5, for each DY group, mean and median raw price ratios (RPRs) and abnormal returns (ARs), with their respective tests of significance are calculated. We report results for the periods “*before*” (1996-2000) and “*after*” (2001-2005) the change of the ex-dividend day price adjustment method.

#### Please insert Table 5 here

In Table 5, for the period “*before*” the change of the adjustment method, we find no clear pattern that RPRs increase and that ARs decline as dividend yields increase. In the first three dividend yield Groups (1, 2 and 3), the mean RPR increases with the dividend yield and in the other two Groups (4 and 5) the raw price ratio decreases. Group 5, has the highest mean dividend yield of 10.9545% and should attract attention from ex-day traders since the ex-day AR of this Group is a significant 6.6847%, while, in the other four dividend yield groups the mean ex-day ARs are lower than 2%. The median

---

$\sigma_{ei} / \sigma_{mi}$ : is the standard deviation of the residuals from estimating the market model, normalized by market risk as a proxy for idiosyncratic risk.

AM : is a dummy variable for the adjustment method (AM), which takes on a value of zero (0) for the abnormal returns of the period “*before*” the new adjustment method (period 1996-2000) and a value of one (1) for the abnormal returns of the period “*after*” the introduction (after 30/3/2001) of the new adjustment method (period 2001-2005).

The  $t$  -statistics are in parentheses.

\*\* indicate significance at the 5% level.

ARs and median RPRs, also, fluctuate as the dividend yield increases. Thus, “*before*” the introduction of the ex-day adjustment method, there is no clear clientele effect, median RPRs and median ARs are not affected by the dividend yields, as was expected. Our results are contrary to those of US studies that support the clientele effect that is due to differential taxation between dividends and capital gains, however they are similar to the findings of Kadapakkam and Martinez (2008),

In the period “*after*” the introduction of the new adjustment method, in Table 5, we observe that as the dividend yields increase the mean ARs continue to fluctuate, while the mean RPRs, after an initial fluctuation, increase as dividend yields increase after Group 2. The median ARs increase as the dividend yield increases and drops sharply in Group 5 (the group with the highest dividend yield). The median RPRs have no clear pattern as dividend yields increase. Again, the Group with the highest dividend yield (Group 5) should attract the most attention, the ex-day AR for this Group is only 1.2679% and ARs of the other four dividend yield groups are between 0.74% and 1.4%.

Thus, “*after*” the change of the ex-dividend day price adjustment method we observe that in the highest dividend yield groups, average and median ARs decline compared to the period “*before*”, our results do not provide support for the clientele effect hypothesis confirming our initial findings.

#### 4.6. Relationship between illiquidity and abnormal returns

To further investigate the ex-dividend day price drop we focus on another potential explanatory factor. Amihud and Mendelson (1986) investigate the relationship between stock return and stock liquidity and propose that returns increase in illiquidity. In the case of the ex-dividend day stock price drop, illiquidity may also be a significant impediment affecting the ex-day stock price behavior. If this holds, stocks with a higher (lower) illiquidity ratio indicate that investors will have a larger (smaller) price impact when they place orders of fixed dollar amounts on these stocks and a larger (smaller) price impact hinders (facilitates) the dividend-capturing activities of investors on the ex-dividend day. Thus, we examine share illiquidity –a measure originally proposed by Amihud (2002)– as a proxy of share liquidity.<sup>15</sup>

However, the original Amihud (2002) measure of illiquidity comes with a major shortcoming that was initially identified by Cochrane (2005), who points out that the Amihud (2002) measure

---

<sup>15</sup> The original Amihud (2002) measure of stock illiquidity ( $\text{illiq}_i$ ) is easily calculated using daily price and volume data (in monetary terms). This measure is defined as the average ratio of the daily absolute return of stock  $i$  on day  $t$  ( $R_{it}$ ) to the respective trading volume ( $\text{VOL}_{it}$ ) in euro (value of trade) on that day and it is given by the formula:

$$\text{illiq}_i = \frac{|R_{it}|}{\text{VOL}_{it}}$$

imposes an automatic scaling of illiquidity with firm size, so that “smaller stocks which have smaller dollar volume for the same turnover (fraction of outstanding shares that trade) are automatically more illiquid.” Florakis et al. (2011) argue that the Amihud (2002) measure treats the euro trading volume as a measure of trading activity, which is not comparable across stocks with different market capitalization and therefore carries a significant size bias. Small-capitalization stocks are likely to exhibit lower trading volume (in monetary terms) than large-capitalization stocks even when they exhibit the same turnover ratio. Thus, small-capitalization stocks will be automatically characterized as “illiquid” only due to their size. Finally, Brennan et al. (2013) argue that “it makes sense to estimate the illiquidity return premium using a measure of illiquidity that relies on turnover as the measure of trading activity”.

To avoid the limitation of the original Amihud (2002) measure of share illiquidity, we follow Florakis et al. (2011) and Brennan et al. (2013) and replace the monetary trading volume in the denominator with the stock’s turnover ratio. We refer to the new share illiquidity ratio as the ‘Turnover-adjusted illiquidity measure’ or “TRilliq” (we use both terms interchangeably) and is calculated as follows:

$$TRilliq_{it} = \frac{|R_{it}|}{TR_{it}}$$

where:  $R_{it}$  : is the return of stock  $i$  on day  $t$  and

$TR_{it}$  : is the daily turnover ratio of stock  $i$  on day  $t$ , measured as follows

$$TR_{it} = \frac{\text{Number of shares traded}_{it}}{\text{Number of shares outstanding}_{it}}$$

To estimate share illiquidity “TRilliq” we need: the daily data on stock returns, the number of shares traded and the number of shares outstanding (in order to calculate the turnover ratio). The measure “TRilliq”, illustrates how much the stock price responds to one percent of turnover rate. Given that the data needed to calculate turnover ratios are available for the ASE and easily accessible in the public domain, the above liquidity ratio, “TRilliq”, inherits the simplicity and data availability that characterizes Amihud’s (2002) original illiquidity measure, while it is free of any size bias. This is because turnover does not necessarily exhibit an inherent size-related pattern (Brown et al. (2009)), also, no one has suggested a reason why small firms should have lower rates of return. Therefore, the turnover-adjusted illiquidity measure is more suitable to examine share illiquidity isolated from the size effect, offering more robust results.

In this section we investigate how the mean and median raw price ratios as well as the mean and median abnormal returns are affected by share illiquidity “*before*” and “*after*” the introduction of the new ex-dividend day price adjustment method. Based on the above measure “TRilliq” we sort our sample in descending order from high to low “TRilliq”, then divide it into five groups of equal size (N=50) and report the associated mean and median raw price ratios, the abnormal returns, and the respective p-values of each group. If share illiquidity (as measured by “TRilliq”) affects stock price behavior by inhibiting the ex-dividend day price drop to equal the dividend paid, we may expect a positive relationship between illiquidity and abnormal returns, and a negative relationship between illiquidity and the raw price ratio. Results for the periods “*before*” (1996-2000) and “*after*” (2001-2005) the institutional change of the ex-dividend day price adjustment method are reported in Table 6.

**Please insert Table 6 here**

For the period “*before*” the change, in Table 6, we observe that illiquidity Group 1 (Highest ‘TRilliq’) has a mean (median) RPR of -83.6683% (0.0000%) and illiquidity Group 5 (Lowest ‘TRilliq’) has a mean (median) RPR of 82.7081% (94.1176%), an increasing trend for both mean and median RPR as illiquidity decreases. However a more detail study reveals that, the mean RPR fluctuates, while the median RPR portrays an increasing trend (a negative relationship). On the other hand both mean and median abnormal returns (ARs), clearly decrease as illiquidity decreases, reflecting a positive relationship between ARs and share illiquidity. Thus, comparing the results of Group 1 and 5 we identify evidence of an illiquidity effect –in Group 5 the price drop approaches the dividend paid and abnormal returns are statistically insignificant.

For the period “*after*” the change, in Table 6, we observe that illiquidity Group 1 (Highest “TRilliq”) has a mean (median) RPR of 56.1273% (25.1009%), while illiquidity Group 5 (Lowest (“TRilliq”) has a mean (median) RPR of 90.4298% (100.000%). When the new adjustment method is introduced there is no clear relationship between share illiquidity and the mean RPR while there is also an almost clear positive relationship between illiquidity and the mean abnormal returns. As for the median values we observe that there is an almost clear negative trend between share illiquidity and the median RPR, and a clear positive trend between abnormal returns and illiquidity (abnormal returns decrease to zero as share illiquidity decreases). In illiquidity Group 5 (Lowest “TRilliq”) the median RPR is equal to the dividend paid (100%) and the mean and median abnormal returns are statistically insignificant, demonstrating that low share illiquidity facilitates dividend capturing by interested investors and improves the market pricing (the median is less exposed to the effect of outliers, Graham

et al. (2003)). In the case of stocks with low share illiquidity the share price drop on the ex-dividend day equals the dividend distributed, and the ex-day abnormal return approaches zero. We observe a full price adjustment relative to the dividends paid, hence, the ex-dividend day puzzle is not present in this particular group.

When comparing the values “*before*” and “*after*” we observe that after the introduction of the new adjustment mechanism there is a clear improvement in mean and median RPR. In illiquidity Group 1 the mean and median RPR both increase from -83.6683% to 56.1273% and from 0.000% to 25.1099% respectively. In illiquidity Group 5 the mean RPR increases from 82.7081% to 90.4298% and the median RPR increases from 94.1176% to 100%. Similarly, in Group 5 mean and median abnormal returns decline to 0.2040% and 0.1602% respectively, therefore, the group of shares that is the least illiquid on average experiences an ex-dividend day price drop equal to the dividend paid and a statistically insignificant ex-day abnormal return.

Thus, low illiquidity facilitates the full price drop on the ex-dividend day which leads to zero ex-day abnormal returns. Our findings argue that the ex-dividend day puzzle is not present in this particular group of shares and propose the degree of share illiquidity as an alternative market microstructure impediment that may inhibit the full ex-dividend price adjustment.<sup>16</sup>

## 5. Summary and Conclusions

In 2001 the ASE switched to a new mechanism to adjust ex-dividend day stock prices. Under the new method, the opening price on the ex-dividend day is set equal to the closing price on the last cum-dividend day. The institutional setting of the ASE –tax-free dividends and capital gains, mandatory dividends, low transaction costs and absence of significant market microstructure impediments– provides a unique opportunity to study the role of the specific regulation change on the ex-dividend price behavior and the market pricing efficiency, also, to identify possible factors explaining the observed behavior.

We investigate a 10-year period (1996-2005) by dividing it into two sub-periods, the first sub-period “*before*” (1996-2000) the introduction of the new ex-dividend day price adjustment method and the second sub-period “*after*” (2001-2005) the initiation of the new method, comparing the respective results. We investigate ex-dividend stock price behavior, abnormal returns, trading volume, the

---

<sup>16</sup> Similar results were obtained in most groups when we applied the original Amihud (2002) illiquidity measure that accounts for the daily trading value (in euros). These results are available upon request.

potential relationship of abnormal returns with the dividend yield and the raw price ratio. We employ a cross section regression analysis to determine variables affecting the ex-dividend returns. Finally we use illiquidity as a measure to further investigate the price adjustment on the ex-day.

We find that the introduction of the institutional feature that changed the adjustment method on the ex-dividend day has significantly altered ex-day stock price behavior in the ASE. The raw price ratio increased on the ex-day from 37% to 62% and the ex-day abnormal returns decreased from 2.26% to 1.18% but remain statistically significant as before the change. The cross sectional analysis showed no evidence that the various variables affect abnormal returns.

Abnormal volume remains similarly significant in both periods (“*before*” and “*after*”); however, volume is slightly smaller in the “*after*” period. Moreover, we do not observe a clientele effect since mean and median, RPRs and ARs are not affected by the dividend yield, (as was expected in the Greek tax-free environment).

We also find that share illiquidity is a dominant driver of ex-day price behavior in the ASE, causing the ex-day premium to deviate from one and the ex-day abnormal returns to deviate from zero. Indeed, we find that in the “*after*” period, the median raw price ratio for low illiquidity shares is 100% and the median abnormal return is close to zero (0.1602%), a full price adjustment relative to the dividends paid. Thus, share illiquidity may represent a potential explanation for the ex-dividend stock price anomaly,

Results suggest that, less legislative intervention improved the pricing efficiency of the ASE, confirming our hypothesis that the new ex-dividend day price adjustment method improved financial market operations and price behavior. Also, share illiquidity appears to be the determinant factor explaining the ex-dividend day stock price-drop in the ASE. Highly liquid shares adjust fully –the ex-dividend day price drop is equal to the dividend paid– and ex-dividend day abnormal returns are zero.

## References

Al-Yahyae, K., Pham, T., & Walter, T., 2008. Ex-dividend day behavior in the absence of taxes and price discreteness. *International Review of Finance*, 8, 103-23.

Amihud, Y., & Mendelson, H., 1986. Asset pricing and the bid-ask spread. *Journal of Financial Economics*, 17, 223-49.

Amihud, Y., 2002. Illiquidity and stock returns: cross-section and time-series effects. *Journal of Financial Markets*, 5, 31-56.

Athens Stock Exchange, Fact book 2002.  
([http://www.ase.gr/content/gr/announcements/Files/FactBook\\_2002.pdf](http://www.ase.gr/content/gr/announcements/Files/FactBook_2002.pdf)).

Bali, R., & Hite G. L., 1998. Ex dividend day stock price behavior: discreteness or tax induced clienteles? *Journal of Financial Economics*, 47, 127-59.

Barclay, M. J., 1987. Dividends, taxes, and common stock prices before the income tax. *Journal of Financial Economics*, 13, 31-44.

Bell, L., & Jenkinson, T., 2002. New evidence of the impact of dividend taxation and on the identity of the marginal investors. *Journal of Finance*, 57, 1321-46.

Bhardwaj, R. K., & Brooks, L. D., 1992. The January anomaly: Effects of low share price, transaction costs, and bid-ask bias, *Journal of Finance*, 47, 553-75.

Boyd, J., & Jagannathan, R., 1994. Ex-dividend price behavior of common stocks. *The Review of Financial Studies*, 7, 711-41.

Brown, J., Crocker, D., & Foerster, S., 2009. Trading volume and stock investments. *Financial Analysts Journal* 65, 67-84.

Brennan, M., & Subrahmanyam, A., 1996. Market microstructure and asset pricing: on the compensation for illiquidity in stock returns. *Journal of Financial Economics*, 41, 441-64.

Brennan M., Huh, S., & Subrahmanyam A., 2013. An analysis of the Amihud illiquidity premium. *Review of Asset Pricing Studies*, 21, 133-76.

Castillo, A., & Jakob, K., 2006. The Chilean ex-dividend day. *Global Finance Journal*, 17, 105-18.

Cloyd, B., Li, O., & Weaver, C., 2006. Ticks and tax: The effects of price discreteness and taxation on ex-dividend day returns, *The Journal of the American Taxation Association*, 28, 23-46.

Cochrane, J. 2005. Asset Pricing Program Review. *NBER Reporter* 5:1-12.

Dasilas, A., 2009. The ex-dividend day stock price anomaly: Evidence from the Greek stock market. *Financial Markets and Portfolio Management*, 23, 59-91.

Dhaliwal, D., & Oliver Z. Li., 2006. Investor tax heterogeneity and ex-dividend day trading volume. *Journal of Finance*, 61, 463-90.

Dubofsky, D., 1992. A market microstructure explanation of ex-day abnormal returns. *Financial Management*, 21, 32-43.

Easley, D., Hvidkjaer, S., & O'Hara, M., 2002. Is information risk a determinant of asset returns? *Journal of Finance*, 57, 2185-221.

Eleswarapu, V. R., 1997. Cost of transacting and expected returns in the NASDAQ market. *Journal of Finance*, 52, 2113-27.

Elton, E., & Gruber, M., 1970. Marginal stockholders tax rates and the clientele effect. *Review of Economics and Statistics*, 52, 68-74.

Elton, E. J., Gruber, M., & Blake, C. R., 2005. Marginal stockholder tax effects and ex-dividend-day price behavior: Evidence from taxable versus non-taxable closed-end funds. *Review of Economics and Statistics*, 87, 579-86.

Florakis, C., Gregoriou, A., & Kostakis, A., 2011. Trading frequency and asset pricing on the London Stock Exchange: Evidence for a new price impact ratio. *Journal of Banking and Finance*, 35, 3335–50.

Frank, M., & Jagannathan, R., 1998. Why do stock prices drop by less than the value of the dividend? Evidence from a country without taxes. *Journal of Financial Economics*, 47, 161-88.

Graham, J. R., Michaely, R., & Roberts, M., 2003. Do price discreteness and transactions costs affect stock returns? Comparing ex-dividend pricing before and after decimalization. *Journal of Finance*, 58, 2611-35.

Grammatikos, T., 1989. Dividend stripping, risk exposure and the effect of the 1984 Tax Reform Act on the ex-dividend day behavior. *The Journal of Business*, 62, 157-73.

Green, J., 1980. Taxation and the ex-dividend day behavior of common stock prices. NBER Working Paper, No W0496. (<http://www.nber.org/papers/w0496>).

Green, R., & Rydqvist, K., 1999. Ex-day behavior with dividend preference and limitations to short-term arbitrage: The case of Swedish lottery bonds. *Journal of Financial Economics*, 53, 145-87.

Heath, D. C., & Jarrow, R., 1988. Ex-dividend stock price behavior and arbitrage opportunities. *Journal of Business*, 61, 95-108.

Jakob, K., & Ma, T., 2004. Tick size, NYSE rule 118, and ex-dividend day stock price behavior. *Journal of Financial Economics*, 72, 605-25.

Johnson, N., 1978. Modified T-Tests and confidence intervals for asymmetric population. *Journal of American Statistical Association*, 536-44.

Kadapakkam, P. R., 2000. Reduction of constraints on arbitrage trading and market efficiency: An examination of ex-day returns in Hong Kong after introduction of electronic settlement. *Journal of Finance*, 55, 2841-61.

Kadapakkam, P. R., & Martinez, V., 2008. Ex-dividend returns: The Mexican puzzle. *Journal of Banking and Finance*, 32, 2453-61.

Kalay, A., 1982. The ex-dividend day behavior of stock prices: A re-examination of the clientele effect. *Journal of Finance*, 37, 1059-70.

Karpoff, J. M., & Walkling, R. A., 1988. Short-term trading around ex-dividend days: Additional evidence. *Journal of Financial Economics*, 21, 291-98.

Karpoff, J. M., & Walkling, R. A., 1990. Dividend capture in NASDAQ stocks. *Journal of Financial Economics*, 28, 39-65.

Koski, J., L., & Scruggs, J., T., 1998. Who trades around the ex-dividend day? Evidence from NYSE audit file data. *Financial Management*, 27, 58-72.

Kyle, A., 1985. Continuous auctions and insider trading. *Econometrica*, 53, 1315-35.

Lakonishok, J., & Vermaelen, T., 1986. Tax induced trading around ex-dividend days. *Journal of Financial Economics*, 16, 287-319.

Michaely, R., 1991. Ex-dividend day stock price behavior: The case of the 1986 tax Reform Act. *Journal of Finance*, 46, 845-60.

Michaely, R., & Murgia, M., 1995. The effect of tax heterogeneity on prices and volume around the ex-dividend day: Evidence from the Milan Stock Exchange. *Review of Financial Studies*, 8, 369-99.

Michaely, R., & Vila, J., 1995. Investors' heterogeneity, prices and volume around the ex-dividend day. *Journal of Financial and Quantitative Analysis*, 30, 171-98.

Michaely, R., & Vila, J., 1996. Trading volume with private valuation: Evidence from the ex-dividend day. *Review of Financial Studies*, 9, 471-509.

Milonas, N., & Travlos, N., 2001. The ex-dividend day stock price behaviour in the Athens stock market. Working Paper. ([http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=274080](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=274080)).

Milonas, N., Travlos, N., Xiao, J., & Tan, C., 2006. The ex-dividend day stock price behaviour in the Chinese stock market. *Pacific-Basin Finance Journal*, 14, 155-74.

Naranjo, A., Nimalendran, M., & Ryngaert, M., 2000. Time variation of ex-dividend day stock returns and corporate dividend capture: A re-examination. *Journal of Finance*, 55, 2357-72.

Shefrin, H., & Statman, M., 1984. Explaining investor preference for cash dividends. *Journal of Financial Economics*, 13, 253-82.