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The Ex-dividend day Effect on the Stockholm Stock Exchange

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Abstract

Our thesis documents the ex-dividend day effect on the Stockholm stock exchange for the period 2000 to 2011. In a perfect capital market, when a share goes ex-dividend, the price of the share should fall by the amount of the dividend, ceteris paribus. Using event study methodology we estimate the abnormal return on the ex-dividend day. The estimated abnormal returns are compared with the dividend yield of the included companies. We find no strong statistical or economical evidence that supports the existence of the ex-dividend day effect on the Stockholm stock exchange. We also control for abnormal returns during the days surrounding the ex-dividend day, and we cannot conclude that the market is inefficient.

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1 Introduction

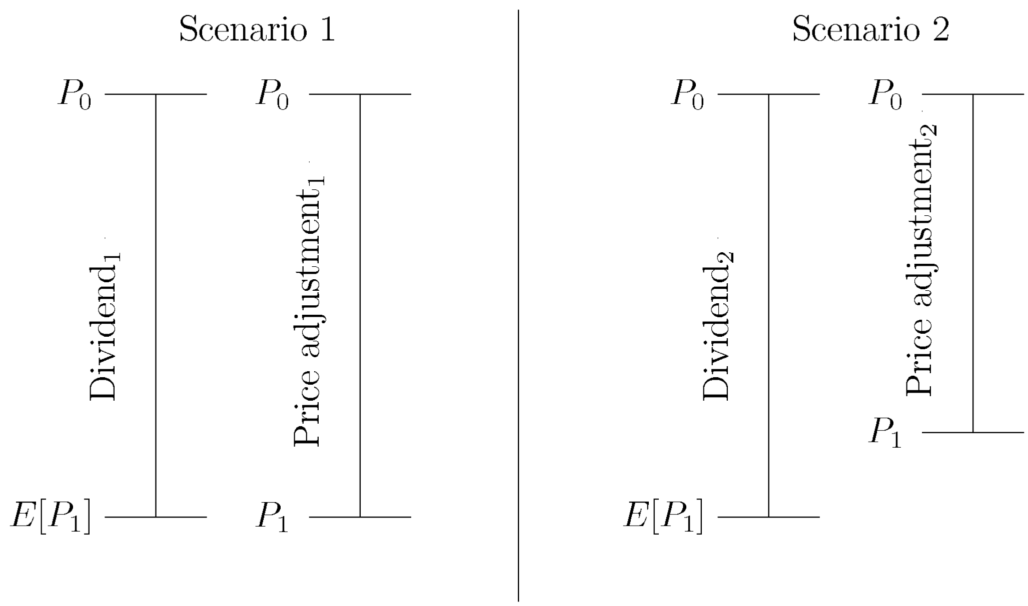
Many companies use dividend payments to reward their shareholders. However, the equity of a company decreases when a dividend payment is made. Thus, the value of the company will be lower than before the dividend payment, i.e. the share price decreases. According to the Efficient Market Hypothesis (EMH) (Fama, 1970), at the day were the right to the dividend is separated from the share, the absolute value of the price adjustment should equal the amount of the capital loss. This is because the EMH claims that, in an efficient market, all available information is reflected in the current share price. The day where the right to the dividend is separated from the share is the so called ex-dividend day (ex-day). The day before the ex-day is the cum-dividend day (cum-day). In a perfect capital market the price drop on the ex-day, with respect to the cum-day price, should equal the dividend, ceteris paribus.

The dividend payment process starts with an announcement that a dividend will be paid out. This is known as the announcement day. Depending on the expected dividend, the share price may go up or down. Since new information becomes public, the EMH says that a reaction on the stock market is explainable. A few weeks after the announcement day, the ex-day occurs. To be able to receive dividend from a company, it is necessary to own shares in that company on the cum-day. After another week or so, the actual payment is made, called payment day. At the payment day no new information becomes available regarding the dividend, therefore the share price should not be affected by the payment of the dividend. This means that the dividend payment process consists of two days were there, according to the EMH, could exist stock returns that could be traced back to the size of the dividend amount. These are the announcement day and the ex-day.

Especially the price adjustment on the ex-day has been studied extensively. Earlier studies, e.g. Elton and Gruber (1970) and Daunfeldt (2002), find that the absolute value of the price adjustment on the ex-day is less than the value of the dividend. This is the so called ex-dividend day effect. It can be an inefficiency and therefore it may invalidate the EMH. Due to the findings of a price adjustment less than the dividend amount, earlier studies also examine possible reasons for this discrepancy. There are three causes mentioned throughout the literature. The first cause is different taxes on capital gains and dividends. This is called the differential tax hypothesis. The second cause is that share price movements are not continuous, they are discrete (Bali and Hite, 1998). This is because the tick size, which is the minimum share price movement, is not always a multiple of the dividend. The third cause is the momentum of share prices. Closing prices are often used both on the cum-day and the ex-day. Therefore it is necessary to consider the expected normal return on the ex-day. If this is not taken into account, the results are misleading, which e.g Michaely (1991) mentions. Figure 1 shows two different scenarios regarding the price adjustment on the ex-day.

Figure 1: Price adjustments

This figures shows two of many possible scenarios regarding the share price movements on the ex-day. Both scenarios start at the same share price, P_0. In scenario 1 the dividend amount is equal to the price adjustment, which means that the share price decreases to the expected price on th ex-day, $E[P_1]$. In scenario 2 the price adjustment on the ex-day is not equal to the dividend amount, i.e. the expected ex-day price, $E[P_1]$, is not equal to the actual ex-day price (P_1).



We have established that the price drop on the ex-day, with respect to the cum-day price, should equal the dividend. This implies that there should be a return equal to the dividend yield, calculated with respect to the cum-day price, on the ex-day if we only consider the effect of the separation of the dividend right from the share. The market is aware of the separation and therefore adjusts for it. Also, if no new information is released on the days surrounding the ex-day, there should not be any unusual price movements on these days. However, earlier studies investigating the ex-dividend day effect have found unusual price movements on these days. Therefore we find it interesting to test if there are abnormal returns on a regular basis at the Stockholm stock exchange (SSE) on the ex-day and the days surrounding the ex-day. We do the latter to control for adjustments in share prices prior to the ex-day and after the ex-day. This is also a indirect test of the EMH. We use a period of 12 years, from 2000 to 2011, which means that our study is one of the largest on Swedish data. We believe that Swedish settings, with equal taxes on dividends and capital gains plus a large amount of companies that pay annual dividend, is an excellent market to conduct this type of research. We aim to answer the following research questions:

1. *Is there a difference between the dividend yield and the abnormal return on the ex-day?*

2. *Do the days surrounding the ex-day have normal returns?*

3. *What are the underlying causes if there is a statistical difference between the dividend yield and the abnormal return on the ex-day?*

Hence, the objective of this thesis is to test if there really is an ex-dividend day effect on the SSE. We use event study methodology, which means that we statistically evaluate the impact of the ex-day event on share prices for different companies. This type of study has not previously been done in this extent on Swedish data. It is a relevant topic, since dividends and their effect on share prices are related to other areas in finance. It is important to understand how dividends affect share prices, since dividends are a part of the return of an investment. Also, if no underlying causes for the ex-dividend day effect exist, it violates the EMH.

Our main results are that we find no strong statistical or economical evidence that supports the existence of an ex-dividend day effect on the Stockholm stock exchange. Furthermore, we find no conclusive evidence that the days surrounding the ex-day exhibit unusual price movements. Therefore, we cannot conclude that the market is inefficient.

The structure of our study is as follows. In section 2, previous literature in this topic is presented. In section 3, the method of the thesis is introduced. In section 4, we present how we collect and process the data. Section 5 presents the results. In section 6, we summarize and conclude the thesis.

2 Literature review

In this section, we discuss previous research done in this topic. First, we present studies done on American data. Second, we present studies done on Swedish data. We also state the Swedish institutional settings.

2.1 Studies using American data

The study by Campbell and Beranek (1955) is one of the first published on the topic of the ex-dividend day effect. They study the effect on the New York Stock Exchange (NYSE). The authors use the closing price of the cum-day versus the opening price of the ex-day. They find that the average price adjustment is roughly 90 percent of the dividend, i.e. the price decrease on the ex-day is smaller than the dividend amount.

In an influential paper from 1970, Elton and Gruber develop a new method to estimate the effect dividends have on share prices on the ex-day. This method also includes a reason why the average price adjustment on the ex-day is not equal to the dividend. According to Elton and Gruber (1970), a rational investor should be indifferent between selling the shares on the cum-day, thereby losing the right to the dividend, and selling on ex-day. This is because, as mentioned in section 1, the price adjustment on the ex-day should be equal to the dividend. Therefore a rational investor will consider these two options as equally good. This is in the absence of taxes. Or rather, this is in absence of different taxes on dividends and capital gains. They present this formula:

$$P_{cum} - t_c(P_{cum} - P_0) = P_{ex} - t_c - (P_{ex} - P_0) + D(1 - t_D) \tag{1}$$

where

- P_{cum} =*Price on the cum-day*
- P_{ex} =*Price on the ex-day*
- P_0 =*Purchasing price*
- t_c =*Tax on capital gains*
- t_D =*Tax on dividends*

Rearranging, we get

$$\frac{P_{cum} - P_{ex}}{D} = \frac{1 - t_d}{1 - t_c} \tag{2}$$

In Equation (2) (henceforth the Elton-ratio), it becomes clear that the price adjustment on the ex-day not necessarily must equal the dividend. Elton and Gruber (1970) consider taxes on capital gains and dividends as important factors when considering the ex-dividend day effect. This is the so called differential tax hypothesis and it is the first argument that explains why it is not necessary for the price adjustment on the ex-day to be equal to the dividend. It is important to remember that this formula is based on the assumption that the market is efficient. It should also be noted that the Elton-ratio assumes that an investor gets a full refund of the taxes on the capital gains. As we know from real life, the taxation on capital gains is a little more complex. An investor is allowed, at least in Sweden, to subtract former capital losses against capital gains. Therefore the marginal tax on capital gains will differ from investor to investor. When using the Elton-ratio, we must therefore be aware of the problem with the marginal taxation. The Elton-ratio can be seen as a follow up to the methodology of Campbell and Beranek (1955). The difference between them is the right-hand side of the Elton-ratio, which is added by Elton and Gruber (1970).

Elton and Gruber (1970) investigate the tax effect on the New York Stock Exchange (NYSE) in 1966-67. They use the closing price on the cum-day and the closing price on the ex-day. They find that the average price adjustment on the ex-day with respect to the dividend is 0.78. With a significance level of five percent, they are able to reject the hypothesis of a Elton-ratio equal to 1. Many studies use the Elton-ratio, e.g. Barclay (1987) and Michaely (1991), when they study the effect the dividend have on the ex-day share price, either in it its original form or in a modified version.

Barclay (1987) controls the validity of the Elton-ratio by comparing two time-periods. The first period is from 1900 to 1910. In this time-period there was no tax on dividends and capital gains. During these circumstances the Elton-ratio should equal 1. The second time period Barclay (1987) examines span from 1962-1985. During this time period there was a difference between the tax on capital gains and the tax on dividends, which means that the Elton ratio should not equal 1. In the first time period, when the taxes on capital gains and dividends were equal, Barclay (1987) finds no statistical significant difference between his Elton-ratio and 1. However, he finds a statistical difference between his Elton-ratio and 1 in the second period. Barclay (1987) therefore argues that arbitrage opportunities arose after the enactment of the federal income tax. This is, according to the author, evidence that supports the differential tax hypothesis and therefore validates the Elton-ratio.

In 1986 there was another tax reform in the US. It reduced the difference between the tax of capital gains and dividend income in 1987 and equalized it in 1988. Michaely (1991) examines the behaviour of share prices on the ex-day during and after this reform. The author uses the ex-day closing price, but he adjusts the closing price by the expected daily return, i.e. he adjusts for the momentum. Then he uses the Elton-ratio and tests statistically if the Elton-ratio equals 1.

Michaely (1991) also controls the behaviour of the share prices around the ex-day. He concludes that the average Elton-ratio is similar before and after the change of the American tax policy, which means that the change of tax policy did not affect the Elton-ratio. This means that the results of Michaely (1991) does not support the differential tax hypothesis. He also finds that unusual price movements are not limited to the ex-day.

Kalay (1982) argues that the method Elton and Gruber (1970) use can be subject to different biases. One example of a bias is the use of the closing prices for both the cum-day and ex-day. This leads to an underestimation of the price adjustment on the ex-day since the expected return on the ex-day is not taken into account. This is the momentum of the share price that Michaely (1991) control for. Kalay (1982) shows that this bias can seriously affect the results. The author uses the Elton-ratio, but he also adjusts the data for the mentioned bias. He concludes that the Elton-ratio is still smaller than one, but in contrast to e.g. Elton and Gruber (1970), it is not statistically significant.

Price discreteness is the second argument that explains why it is not necessary for the price adjustment on the ex-day to be equal to the dividend. An investor cannot always buy a share at any price he likes. This implies that share prices are not continuous, they are discrete. The minimum amount the price of a share can increase or decrease is called a tick. Bali and Hite (1998) claim that the existence of tick sizes cause problems for investors since the dividend may not be an exact multiple of the tick size. Hence, it is not always possible for the left-hand side of the Elton-ratio to be equal to one, even though there are equal taxes on capital gains and dividends. They argue that the price adjustment equals one tick below the amount of the dividend.

A simple example of the tick size problem is if we have a share traded at 20 SEK and the tick for that particular share is 0.1 SEK. Let us then assume the dividend on that stock is 0.25 SEK, meaning it is not a multiple of the tick. Thus, it is impossible for the price adjustment to be equal to 1 since the dividend lies between two ticks. According to Bali and Hite (1998), the ratio between the dividend amount and the price adjustment caused by the dividend should be smaller than 1, not equal to 1. They argue that the reason for this is that an investor never likes to over-adjust for the dividend. Bali and Hite (1998) also claim that the larger a dividend becomes, the less important the tick size is. Thus, the price discreetness is, according to them, less of a problem in countries like Sweden.

Because the critique of the tax differential theory, Elton, Gruber and Blake did a new study in 2005. They argue that the different tax structure is the main explanation for the ex-dividend day effect. In their paper, they test the different tax effect on close-end mutual funds. What makes the close-end mutual funds an interesting sample, is according to Elton et al. (2005) that it contains a set of securities (municipal bond funds) for which the ex-day price adjustment should be greater than the dividend if taxes matter, and a set of securities (taxable bonds) where the drop on average should be less than the dividend. The authors tests if the average Elton-ratio for a sample of US dividend-paying closed-end funds, for which dividends are tax-exempt but capital gains are still taxed, is indeed larger than the Elton-ratio. This is also what they find. They therefore reject the hypothesis that the price adjustment on the ex-day is dependent on any microstructure arguments, like price discreetness, since this would be to argue that the price adjustment on the ex-day always will be smaller than the dividend.

2.2 Studies using Swedish data

The studies we discuss in previous section are all done on American data. The most important elements to consider in these studies are the differential tax hypothesis, the momentum effect and price discreteness. Since we are examining the ex-dividend day effect on the Stockholm stock exchange (SSE), it is important to investigate which conclusions previous studies on the SSE have reached about the ex-dividend day effect and its connection to the mentioned elements. However, we begin this section by giving a brief description of the Swedish institutional settings.

In Sweden there are equal tax rates for capital gains and dividends and they have been equal during our whole sample period. This means that in equation (2), t_c equals t_D for Swedish shareholders. This is of great importance since then equation (3) must hold for Swedish investors on the SSE:

$$\frac{P_{cum} - P_{ex}}{D} = 1 \tag{3}$$

If only Swedish investors participated in the trading on the Stockholm stock exchange, the Elton-ratio should be equal to one according to Elton and Gruber (1970). However, there are foreign investors active on the SSE. In 2009, 35 percent of the investors on the SSE were foreign[1]. When conducting a study like this, foreign investors complicate the methodology. Due to time constraints, we will not address each investor's tax situation since it will differ from country to country. Hence, we do not consider any foreign investors. Therefore, we assume that the Elton-ratio should equal 1.

Another problem to take into consideration is that Swedish companies often have their annual general meeting on the cum-day. This does not affect the actual value of the dividend, but depending on the expectations of the annual general meeting, the share price may move up or down. However, when we consider the full sample these fluctuations should cancel each other out. This means that if there is an abnormal return on the ex-day, it can be considered to be caused by the separation of the right to the dividend from the share.

[1] http://www.svd.se/naringsliv/utlandska-agare-prickade-ratt_3285875.svd

The existence of foreign investors on the SSE and the fact that Swedish companies often have their annual general meeting on the cum-day, can cause another problem regarding the ex-dividend day effect. It is possible that a large Swedish shareholder want to increase his ownership in a company prior to the annual general meeting, in order to get more voting power. A foreign investor may want to avoid dividends in Sweden because it may complicate the tax situation for him. Therefore, these two types of owners can come to an agreement. For example, a forward contract can be specified to satisfy both their needs. The Swedish shareholder can borrow the shares in the company, from the foreign investor, for a predetermined period of time. Then the Swedish shareholder gets more voting power on the annual general meeting, while the foreign investor avoids tax responsibilities regarding the dividends. This may affect the price movements on the days surrounding ex-day. But as we previously stated, we will not address each investor's tax situation due to time constraints since it will differ from country to country.

One early study on Swedish data is Claesson (1987). She does not consider the right-hand side of the Elton-ratio. This is despite the fact that the tax on capital gains and dividends are different in the time period she examines. The study is done on the Stockholm stock exchange from 1978 to 1985 and includes 49 companies. She finds a price ratio of 0.984. This price-ratio corresponds to the left-hand side of the Elton-ratio and she does not find a significant difference between this ratio and 1.

Claesson (1987) also studies the abnormal return for single days prior to and after the ex-day. This is done by comparing the return on stocks with dividend payments with the return of the whole market. Claesson (1987) uses this method to estimate the abnormal return on each day in the event window. This method has similarities with the method we use. However, instead of using the whole market as a benchmark we estimate the abnormal returns directly by using past price movements of each share. Claesson (1987) finds that the cumulative return 15 days prior to the ex-day is on average 47 percent higher for stocks with dividends than the whole market. The author also examines each single day's return in the event window. She finds that largest difference between return for stocks that pays dividends and the return for the whole market is two to four days prior to the ex-day. This is similar to the results Michaely (1991) finds using American data.

Daunfeldt (2002) studies the tax effect on the SSE from 1988 to 1995 in connection with the ex-day. This period is chosen since there have been major changes in the Swedish taxation system during this period. This study is comparable to the study of Michaely (1991). They both examine the Elton-ratio during changes in taxation systems. Daunfeldt (2002) divides his sample into four periods and examines them separately and together. He finds that the changes in the Swedish tax system do not affect the Elton-ratio, which is what Michaely (1991) finds on American data.

Additionally, Daunfeldt (2002) finds that the price adjustment on the ex-day is closer to the dividend the larger the dividend is. This can be explained by the fact that dividends are taxed immediately while capital gains are taxed on realization. Another explanation is that the tick size becomes relatively more important the smaller the dividends are. Daunfeldt (2002) therefore give support for the price discreetness hypothesis.

In a more recent study, Hedman and Moll (2006) also find evidence that indicates that the tick-size is an important factor when examining the ex-dividend day effect. They investigate the ex-dividend day effect on the SSE. They use the Elton-ratio and find that between 2000 and 2005, the average price adjustment on the SSE is 72 percent of the dividend. This Elton-ratio is highly significant, with a p-value that virtually equals 0. They also find that if a dividend is not an exact multiple of the tick size, the price adjustment will be lower than the dividend.

3 Method

In this section we present the method we use in this thesis. First we show how the abnormal return is calculated and how we draw statistical inference. The section ends with the presentation of our hypotheses.

As we mentioned in the beginning of section 2, the Elton-ratio is a well-used metric when analyzing the effect dividends have on share prices on the ex-day. As we state in section 2.2, the taxes on capital gains and dividends are equal in Sweden, hence we only use the left-hand side of the Elton-ratio. Since we do not consider foreign investors, the Elton-ratio in our study is expected to equal 1. We estimate the abnormal returns using a regression framework, therefore we also examine the difference between the price adjustment on the ex-day and the dividend. This method allows us to also examine the behaviour of the days surrounding the ex-day, and thereby assess the efficiency of the market.

3.1 Estimation of the abnormal returns

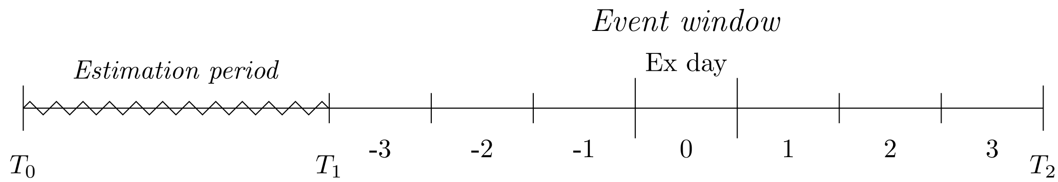
To calculate the Abnormal Return (AR) we use the CAPM framework to measure the normal return. CAPM is chosen in favour of the market model because it, contrary to the market model, incorporates the risk-free interest rate. During the last decade there have been big shifts in the risk-free interest rate and therefore it is important to include it in the model. The CAPM model is

$$\begin{aligned} &R_{it} - R_{ft} = \alpha_i + \beta_i(R_{mt} - R_{ft}) + \varepsilon_{it} \\ &E(\varepsilon_{it}) = 0 \quad VAR(\varepsilon_{it}) = \sigma^2_{\varepsilon_i} \end{aligned} \tag{4}$$

The measurement and analysis of the AR study follows the methodology of MacKinlay (1997). First the event day is specified (the ex-day) as $\kappa = 0$. The event window is equal to $\kappa = T_1 + 1$ to $\kappa = T_2$. $\kappa = T_0$ to $\kappa = T_1$ is the estimation period. The length of the event window and the estimation period equals $L_1 = T_2 - T_1$ and $L_2 = T_1 - T_0$. We use a seven day event window (L_1). The reason for this is that it becomes possible to study what happens on the actual event day (the ex-day) and also to control for adjustments in the price before and after the event day. This means that for the event window, κ spans from -3 to 3. We choose a 30 day estimation period (L_2) to ensure that the distribution of our t-test follow the standard normal. The time-line is visible in Figure 2.

Figure 2: Time-line

This figure shows the time-line in our study. The event window is equal to κ=$T_1 + 1$ to κ=T_2. κ=T_0 to κ=T_1 is the estimation period. The ex-day corresponds to $\kappa = 0$.



To measure the CAPM model parameters we use Ordinary Least Squares (OLS). This method produces efficient and consistent estimates of the parameters given the assumptions in equation (4) (MacKinlay, 1997). For each security and year the sample Abnormal Return (AR) is

$$AR_{i\kappa} = R_{i\kappa} - E[R_{i\kappa}] \tag{5}$$

$$AR_{i\kappa} = R_{i\kappa} - \hat{\alpha}_i - \hat{\beta}_i(R_{m\kappa} - R_{f\kappa}) \tag{6}$$

In equation 5 it is visible that the AR is equal to the disturbance term in the CAPM model. Since the estimation window and the event window do not overlap, the disturbance term is calculated on an out of sample basis. As can be seen in the equations above, we need the daily return for each company and also the daily risk-free rate to estimate the AR. We use the following formulas to calculate them

$$R_{i\kappa} = \ln\left(\frac{P_\kappa}{P_{\kappa-1}}\right) \tag{7}$$

$$R_{f\kappa} = (1 + R_{F\kappa})^{(1/360)} - 1 \tag{8}$$

where $R_{i\kappa}$ is company is return for day κ. P_κ is the share price at day κ and $P_{\kappa-1}$ is the share price the day before day κ. $R_{f\kappa}$ is the risk-free interest rate at day κ and $R_{F\kappa}$ is the yearly risk-free interest rate at day κ.

To calculate the actual difference between the ex-day abnormal return and the dividend we need to calculate the dividend yield, which is given by

$$\text{Dividend Yield}_{iy} = \frac{D_{iy}}{P_{ciy}} \tag{9}$$

where Dividend Yield_{iy} is the dividend yield for company i year y, $D_i y$ is the cash dividend year y for company i. P_{ciy} is the cum-day close price for company i year y.

We base our analysis of the ex-dividend day effect on the closing price. As e.g. Kalay (1982) and Michaely (1991) argue, it is necessary to adjust the closing price. The effect of the dividend is underestimated because a whole day has passed since the prices, according to EMH, should have decreased by the dividend yield. We use the following formula to adjust the price

$$\text{Adjusted } P_i = \frac{P_i}{(1 + E(R_i))} \tag{10}$$

where $E(R_i)$ is the CAPM estimated normal return for company i. We only use this method to calculate the return on the day ex-day since this is the only day that, according to EMH, should be affected by the separation of the dividend right from the share. For the different $\overline{CAR}_{\kappa_1,\kappa_2}$, which we discuss in Section 3.2, we use the unadjusted ex-day price because we are interested how the total abnormal return over the period have been. If we instead use the adjusted price on the ex-day to calculate the return we are inconsistent. This is because we use unadjusted closing prices to estimate the abnormal returns for the other days in the event window.

3.2 Statistical inference

To draw statistical inference from the test it is necessary to take average of the individual securities. The formula follows

$$\overline{AR}_\kappa = \frac{1}{N}\sum_{i=1}^{N} AR_{i\kappa} \tag{11}$$

Where N is the number of companies, i is the individual security and κ is the day in the event window to which the $\overline{AR}$ corresponds. Using this estimate it is possible to analyze the abnormal return for the whole sample and also for each individual year. On the ex-day we expect to find an $\overline{AR}$ return that is equal to the dividend but with a negative sign. This is because the CAPM estimation of the normal return does not expect that a dividend is too be paid out. Therefore, according to EMH, there should be an abnormal return that corresponds to the dividend on the ex-day. We take the difference between these two variables, henceforth the *Difference*. We discuss the statistical test more thoroughly later in this section. We also divide the $\overline{AR}_\kappa$ on the ex-day ($\kappa = 0$) by the average dividend yield to get a ratio of the abnormal return with respect to the dividend payment.

To statistically test the significance of this ratio, which is equal to the Elton-ratio, we use a normal cross-sectional t-test, which is given by equation 13. We use the average of the two variables because we want every single observation to have equal weights. This method of calculation is called a equally-weighted calculation. E.g. Claesson (1987) uses this method. It is also possible to first divide each single abnormal return with respect to the corresponding dividend yield and then take the average, which is value-weighted calculation. E.g Elton and Gruber (1970) use this method. However, this leads to shares with low dividend yields are getting higher weights. We use the equally-weighted calculation because we believe it is more interesting when every observation have equal weights. When we henceforth discuss the abnormal return on the ex-day and the *Difference* we mean the adjusted abnormal return and adjusted *Difference* if nothing else is mentioned.

We also study what happens prior the event-day and after the event-day. We do this by aggregating the $\overline{AR}_\kappa$ for different intervals in the event window, from κ_1 to κ_2. This gives the following

$$\overline{CAR}_{\kappa_1,\kappa_2} = \sum_{\kappa=\kappa_1}^{\kappa_2} \overline{AR}_\kappa \qquad (12)$$

When we calculate the $\overline{CAR}_{\kappa_1,\kappa_2}$ we use the *Difference* together with the other days abnormal returns if the ex-day ($\kappa = 0$) is in the period. The reason fo this is that the *Difference* is the real AR on the ex-day since the share price is expected to drop with the size of the dividend. The difference is in percentage points but the actual return has the same value as the difference. We prove this in Section 5.1.

Normally when performing statistical tests on $\overline{AR}_\kappa$'s and $\overline{CAR}_{\kappa_1,\kappa_2}$'s one can use a normal cross-sectional t-test (t_{no})which equals, in the case of the $\overline{AR}_\kappa$, the following

$$t_{no} = \frac{\overline{AR}_\kappa \sqrt{N}}{\sigma_{\varepsilon\kappa}} \tag{13}$$

Where $\sigma_{\epsilon\kappa}$ is the estimation period standard deviation. The variance of all days in the event-window equals the variance of the residuals in the estimation period, i.e.

$$\sigma^2(AR_{i\kappa}) = \sigma^2_{i\varepsilon} \tag{14}$$

For the CAR_{κ_1,κ_2} the variance equals

$$VAR(\overline{CAR}_{\kappa_1,\kappa_2}) = \sum_{\kappa=\kappa_1}^{\kappa_2} VAR(\overline{AR}_\kappa) \tag{15}$$

However, the normal cross-sectional t-test is based on statistical assumptions that are quite unrealistic. Binder (1998) discusses four problems that potentially can bias the variance downwards, i.e. increase the chance of wrongfully reject the null hypothesis. The ARs 1) may be cross-sectionally correlated, 2) may have different variances across firms, 3) may not be independent through time for a specific firm and 4) variance may be larger during the event-period in comparison to adjacent periods. We do not need to consider the third problem since our event window is short in comparison to the estimation period. The other three problems need to be dealt with since we have clustering of the ex-days for each year.

Boehmer et al. (1991) develop a simple method to deal with the fourth problem (event-induced heteroscedasticity). They show through extensive testing that their method, henceforth BMP, is viable to use when dealing with this problem. The AR's are standardized by their estimated standard deviation (adjusted for forecast errors) of the residuals in the respective estimation period.

$$SAR_{i\kappa} = \frac{AR_{i\kappa}}{\hat{\sigma}_{i\kappa}\sqrt{1 + \frac{1}{L_2} + \frac{(R_t - \overline{R}_m)^2}{\sum(R_{m\kappa} - \overline{R}_m)^2}}} \quad (16)$$

Equation (16) shows the procedure. $SAR_{i\kappa}$ is security i's standardized AR on day κ, $\hat{\sigma}_{i\kappa}$ is security i's estimated standard deviation of the residuals in respective estimation period. L_2 is the number of days in the estimation period, R_{mE} is the market return on the day that is examined. R_{mt} is the market return on day t, $\overline{R}_m$ is the average market return during the estimation period. This method is easily applied on the CAR's by replacing the standard deviation of the residual for day κ ($\sigma_{i\kappa}$)with standard deviation of the residuals for the cumulated days, ($\sigma(\kappa_1, \kappa_2)$). From this we get the Standardized CAR, $SCAR(\kappa_1, \kappa_2)$.

We use equation 11 to get $\overline{SAR}$ and then we apply the regular t-test methodology using the $\overline{SAR}$ ($\overline{SCAR}$) instead of the $\overline{AR}$. This method deal as mentioned with event-induced heteroscedasticity. Boehmer et al. (1991) also show in their study that their method is applicable on clustered data.

3.3 Standardized difference

The BMP method is easily applied on our data (see Section 4 for information about the data). However, there is a problem regarding the *Difference*. Two different variables (the abnormal return on the ex-day and the dividend yield) are used to calculate the *Difference*. Thus, it is difficult to calculate the standard deviation of this combined variable. It is not possible to use the normal standard deviation formula since the standard deviation of the abnormal return for each company is calculated using the abnormal returns of the corresponding estimation period. This means that each abnormal return have its own standard deviation. This is not true for the dividend yield. Even if we have enough observations of dividend yields to calculate the standard deviation, it would be the standard deviation for the full sample period, not for the year. We therefore standardize each observation of the *Difference* by the corresponding estimated standard deviation for the AR on the ex-day.

The *Difference* is calculated as follows

$$\textit{Difference}_{iy} = \text{Dividend yield}_{iy} - AR_{iy} * (-1) \tag{17}$$

where Dividend yield$_{iy}$ is the dividend yield for company i, year y. The AR_{iy} is the abnormal return for company i, year y. A κ subscript is not necessary since we only calculate the *Difference* on the ex-day. We multiply the AR with -1 because the dividend yield is always positive and the expected price adjustment on the ex-day is negative. To be able to take the difference it is necessary that these two variables have the same meaning.

Then the Standardized *Difference* is calculated as follows

$$\text{Standardized } \textit{Difference}_{iy} = \frac{Difference_{iy}}{\hat{\sigma}_{iy}\sqrt{1 + \frac{1}{L_2} + \frac{(R_{mEx} - \overline{R}_m)^2}{\sum(R_{m\kappa} - \overline{R}_m)^2}}} \tag{18}$$

where $\hat{\sigma}_{iy}$ is security i's estimated standard deviation of the residuals in respective estimation period. L_2 is the number of days in the estimation period, R_{mE} is the market return on the day that is examined. R_{mt} is the market return on day t, $\overline{R}_m$ is the average market return during the estimation period. t corresponds to the days in the estimation period. As mentioned previously, this is only done on the ex-day.

3.4 Underlying causes for the ex-dividend day effect

It becomes clear when reading the literature review that most of the previous research done in this area find a difference between abnormal return on the ex-day and the dividend amount. A natural next step would then be to test the underlying causes. In our literature review, we mention three main explanations for the difference. These are the different tax explanation, price discreetness and the momentum effect. Since we adjust the price of the ex-dividend day for the normal return, any further difference between the abnormal return and dividend yield must be caused by another variable.

The variable that the majority of the earlier studies discuss is the differential tax explanation. The tax for Swedish citizens is 30 percent, both on capital gains and dividends. Thus, the difference in taxes between them is zero. Swedish citizens are allowed to offset capital losses. This is true both for capital gains and dividends. Thus, the marginal tax for capital gains and dividends will be the same for all possible scenarios. The tax explanation should therefore not be considered under the current Swedish settings.

It is necessary to need clarify one thing first. As we mentioned before, in July 2009, 35 percent of the total value of the Stockholm stock exchange was owned by foreign investors. Since investors pay taxes in the country that they are living in, 35 percent of the total value is taxed outside of Sweden. Thus, the taxes for these investors will be practically impossible to estimate. Thus, we cannot fully reject the tax explanation, but we believe that it does not have a large effect on the results.

Thus, the only explanation we have left is the tick size explanation. That is, shares that pay dividends which is not an exact multiple of the tick size cannot have an Elton-ratio of one. We use a regression framework to test if the difference can be explained by the tick size variable. We have panel data and use the Hausman test to control for which of the random effects and the fixed effects model that fits the data best. There are some important differences between these two models.

The fixed effects model is named after the fact that it lets each independent variable have its own intercept in the regression. This intercept is fixed for each independent variable. However, it assumes that the slope coefficient is the same for all variables. The fixed effects model can be written as

$$y_{it} = \alpha_i + \beta x_{it} + \psi_{it} \tag{19}$$

where α_i is the intercept for company i, β is variable x's coefficient and ψ_{it} is the error term. The i subscript on the α suggests that the intercept for the different variables used in the regression may be different.

The random effects model can also be written as equation (19). However, in this model α_i is not assumed to be fixed. Instead it is assumed to be a random variable with a mean of α. It can be written as $\alpha_i = \alpha + \varphi$, where φ is a random error term with a mean equal to 0. (Gujarati, 2003, p.642-649)

The Hausman test controls which of the random effects and the fixed effects model that fits the data best. The test assumes that the fixed effect is consistent under both the null hypothesis and the alternative hypothesis. The random effects estimator is consistent and efficient only if the independent variables are uncorrelated with the intercept, which is the null hypothesis. To control the null hypothesis, the statistical significance of the difference between the fixed effects estimator and the random effects estimator is tested. If null hypothesis can be rejected the fixed effects model is preferred. The Hausman test has an asymptotic χ^2 distribution and the test statistics is calculated as follows

$$\xi_H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})'[\hat{V}\{\hat{\beta}_{FE}\} - \hat{V}\{\hat{\beta}_{RE}\}]^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{RE}) \tag{20}$$

where $\hat{V}$ is the estimated covariance matrices, $\hat{\beta}_{FE}$ is the estimated fixed effects coefficient and $\hat{\beta}_{RE}$ is the estimated random effects coefficient. (Verbeek, 2008, p. 368)

We create a dummy variable for the tick size, where one is equal to a dividend that is not an exact multiple. Zero is then equal to a dividend that is an exact multiple. The regression we test looks as follows

$$\text{Standardized } Difference_{iy} = \alpha_i + \beta_{iy} D_{Tick} + \psi_{iy} \tag{21}$$

We use the standardized *Difference* as dependent variable because the heteroscedasticity and cross-correlation is already taken care of when standardizing the variable. Therefore it is not necessary to adjust the dependent variable when performing the panel regression.

3.5 Hypotheses

Based on the research questions and the EMH, we form two different hypotheses that we test. First, according to the EMH there should not be any difference between the dividend yield and the abnormal return on the ex-dividend day:

H_1 : *There is no difference between the dividend yield and the abnormal return on the ex-dividend day.*

When new information becomes public, the price of the corresponding share should be repriced immediately and correctly according to the EMH. Therefore, there should not be any abnormal returns on the days surrounding the ex-dividend day:

H_2 : *There is no abnormal return on the days surrounding the ex-day.*

We also have a third hypothesis that is dependent on the results of the first two. This hypothesis is based on the results of previous research and our third research question. E.g. Elton and Gruber (1970) and Barclay (1987) argue that different taxes on capital gains and dividends cause the so called ex-dividend day effect. In Sweden the taxes on these two capital incomes is equal and therefore the Elton-ratio should equal 1. But studies on the Swedish markets finds that the Elton-ratio is less than one e.g. Hedman and Moll (2006). Bali and Hite (1998) argue that price discreteness can affect the Elton-ratio and therefore we base our third hypothesis on this:

H_3 : *The difference between the dividend yield and the abnormal return on the ex-dividend day is not dependent of the tick size.*

4 Data

In this section we explain how we collect the data, and how we process the data.

4.1 Collection

To examine this topic we need the ex-dividend dates, size of dividend, daily stock data, daily risk-free rates for the Swedish 1 month treasury bill and daily OMX PI prices. The ex-dividend dates, the size of the dividends and the daily stock data is collected from REUTERS. The daily one month treasury bill data from the Swedish central banks homepage[2] and OMX PI index prices from OMX Nordics homepage[3]. We use the REUTERS stock data to calculate the daily returns. However, the share price data from REUTERS is adjusted (e.g for stock splits) and we therefore use OMX share price data[4] to calculate the dividend yields.

The data collected spans from 1/12/1999 to 31/12/2011. The reason for this odd start date, is that we have an observation in the early January 2000, which means we need share prices one month prior to the ex-day. We use the closing prices on the ex-day rather than the opening prices since the first orders are adjusted by the amount of the dividend. Thus, the trades early in the morning are likely to be a biased estimate of the equilibrium market price (Elton and Gruber, 1970). Therefore, we have decided to look at the closing prices instead. However, closing prices can also cause problems. The most obvious one is that the shares have been affected not only by the dividends, but also from a whole day of trading. We therefore adjust for this momentum effect as discussed in section 3.1.

The companies in our survey are all listed on the Stockholm stock exchange at 31/1/2012. This means that we are excluding stocks that previously have been listed, but for some reason (e.g. bankruptcy) do not exist anymore. Furthermore, we are not including companies that do not pay dividends during the time period. Thus, many companies listed on the small cap list are excluded. We also notice that the larger the companies get, the more likely are they to pay out dividends. Companies listed under large cap are therefore likely to be included in our sample. This may be

[2] http://www.riksbank.se/sv/Rantor-och-valutakurser/Sok-rantor-och-valutakurser/

[3] http://www.nasdaqomxnordic.com/index/historiska_kurser/?Instrument=SE0000744203/

[4] http://www.nasdaqomxnordic.com/aktier/historiskakurser/

seen as a bias, but since we are only interested in companies paying dividends, we cannot see any way to deal with the bias.

We consider only companies that have annual dividends, i.e. not quarterly or semi-annually. This is because we only want one observation per company and year, due to the bias issue. When dealing with quarterly or semi-annually dividends, we do find it hard to know which dividends to include and which ones to exclude. We have therefore decided to exclude all shares with a non-annual dividend policy. We only consider cash dividends. Dividends that have been paid out through new shares are excluded, mainly because it is hard to set a fair value of the new shares. If there is a cash dividend and a new shares dividend on the same day we do not consider the particular share that year to avoid a biased response in the return. We have excluded a total of 100 securities that were listed on the SSE at 31/1/2012.

Since we are dealing with shares on the Stockholm stock exchange, we are dealing with share prices in Swedish kronor (SEK). This means that we need to transform cash dividends in other currencies into in SEK. We use the exchange rate on the cum-day to transform all cash dividends. The values are collected from REUTERS. In one sense this will give us a biased sample since basically all dividends in foreign currency, after transformed, are not an exact multiple of the tick size for the share. Thus, according to Bali and Hite (1998), these dividends may on average be less adjusted than the ones paid out in SEK. Also, we only consider one security per company. We use the security that is the most liquid. On the Stockholm stock exchange, this basically means that we are mostly using the B-shares when there is more than one type of share for a company. Lastly, if companies do not have observations on the cum-day or the ex-day at a specific year, this observation is excluded. This is because it is impossible to calculate the return on the ex-day without a share price on either of these days.

This boils down to a sample of 192 companies (securities). For the names of the included companies (shares), see the appendix on page 42. The data is sorted to include an estimation period of 30 days prior to the actual event window, which consists of the ex-day and a pre- and post-event period of three days. This gives a total of 37 days per share and year. Since not all shares have a dividend payment each year, the total amount of observations does not equal 192 times 37. Instead the total amount of observations equals 47322 days and 1391 dividends over the 12 years that we study.

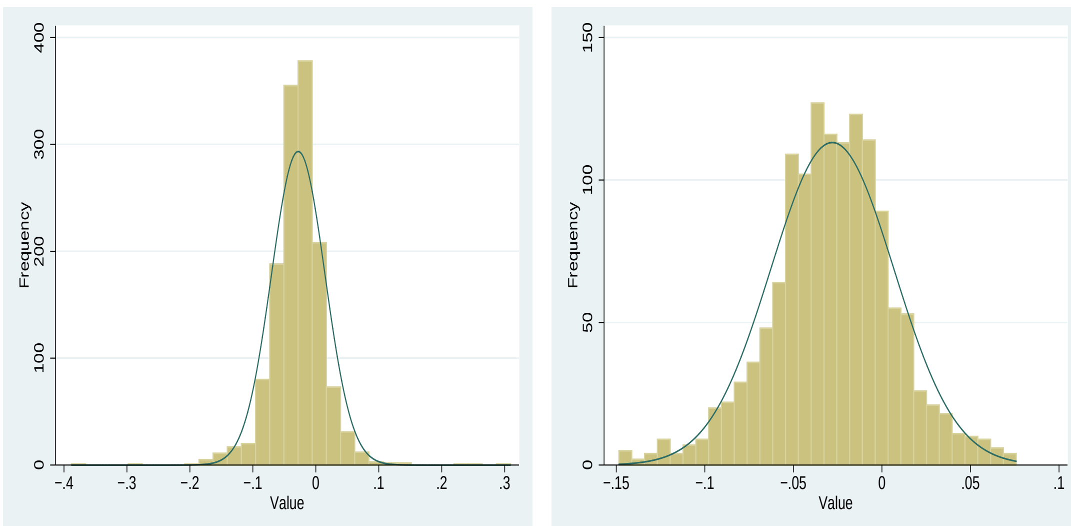
4.2 Attributes of the data

The distribution of the AR on the ex-day is visible in Figure 3a and the summary statistics for the sample is visible in Table 1.

Figure 3: Histogram

This figure shows the distribution of the abnormal returns in relation to the standard normal distribution.

(a) Adjusted Abnormal Return (b) Trimmed Abnormal Return



When studying Figure 3a and Table 1 it becomes clear that the untrimmed data is leptocurtic due to large outliers. In the trimmed data in Table 1 we discard all observations in the first and 99th percentile. In The trimmed data looks better, if we only consider the distribution of the abnormal returns, but the mean of abnormal return is almost unchanged compared to the untrimmed data for the ex-day. When trimming the days surrounding the ex-dividend day the mean changes a little more. The histogram for these variable are in appendix A. We decide to use the untrimmed data since, as Brooks (2008, p.167) state, to much tampering leads to an artificially improved fit of the model and we want to avoid this. So, since the mean is practically unchanged for the ex-dividend day and there are no extreme changes for the other days we use the untrimmed data. Henceforth, when discussing AR, we mean the untrimmed data. When we discuss the difference between the dividend yield and the abnormal return on the ex-day, we write the $Difference$.

Table 1: Summary statistics

In this table the summary statistics of our data is displayed. The mean is calculated using equally-weighted calculations. The σ's for the different days (κ) in the event window are the standard deviation corresponding to the estimation periods. They are not necessarily the same, since the number of observations (N) differs between the different days in the event window. The σ for the Dividend yield is calculated using the basic standard deviation formula.

Variable	Mean	σ	Skewness	Kurtosis	N
Adjusted ex-day	-2.794	0.066	0.007	13.505	1391
Trimmed Adjusted ex-day	-2.799	0.066	-0.193	3.724	1365
Dividend yield	3.241	0.018	1.754	12.1284	1391
$\kappa = -3$	0.164	0.066	1.181	15.079	1377
Trimmed $\kappa = -3$	0.140	0.060	0.348	4.075	1351
$\kappa = -2$	0.217	0.066	-0.221	22.218	1377
Trimmed $\kappa = -2$	0.200	0.058	0.309	4.277	1351
$\kappa = -1$	0.018	0.066	0.015	7.954	1380
Trimmed $\kappa = -1$	0.011	0.066	-0.174	5.050	1354
$\kappa = 1$	-0.231	0.066	-0.475	10.531	1383
Trimmed $\kappa = 1$	-0.222	0.060	0.120	3.835	1357
$\kappa = 2$	-0.130	0.065	0.518	7.451	1372
Trimmed $\kappa = 2$	-0.148	0.059	0.137	3.767	1346
$\kappa = 3$	-0.223	0.066	-0.108	11.393	1369
Trimmed $\kappa = 3$	-0.225	0.065	-0.089	3.628	1343

5 Results

In this section we present our results together with our analysis. We start by presenting our Elton-ratio together with the Elton-ratios of the Swedish studies we discuss in section 2. We continue by presenting the abnormal return for the full sample. Finally, we present our results from examining each individual year for three different variables.

In Table 2, the Elton-ratios from previous Swedish studies is presented. Although it is hard to draw any conclusions, we can see that our result of a price adjustment of 86 percent on the ex-day is the second closest to 1. The difference between the studies can be explained by many factors. Different samples, considering for example time and size, are important to consider.

Table 2: Elton-ratio

This table displays the mean Elton-ratios for the Swedish studies we discuss in the literature review. The t-statistics, p-value and the number of observations (N) is taken from each individual study. The t-statistics tests the null hypothesis of the Elton-ratio equal to 1. Weighting refers to how the mean is calculated. Equal means a equally-weighted Elton-ratio and Value means a value-weighted Elton-ratio. This information is, if not explicitly stated by the author/s, inferred from each study. If no t-statistics and/or p-value are included, it was not presented in the corresponding study.

Author/s	Mean	t-statistic	p-value	Time-period	N	Weighting
Claesson (1987)	0.98	-	-	1978-1985	350	Equal
Daunfeldt (2002)	0.48	-	-	1988-1995	371	Value
Hedman and Moll (2006)	0.72	4.15	0.00	2000-2005	632	Value
Sundberg and Halvorsen (2012)	0.86	1.66	0.096	2000-2011	1391	Equal

Neither t-statistics nor p-value are provided by Claesson (1987) and Daunfeldt (2002). However, as we state in section 2, Claesson (1987) does find a statistical difference between the price adjustment on the ex-day and the dividend. This means that her Elton-ratio is not different from 1. Since the Elton-ratio of Daunfeldt (2002) is below 0.5, we believe it is reasonable to assume that it is statistically different from 1. Therefore, when studying Table 2, we see that the results regarding the ex-dividend day effect on the Stockholm stock exchange are not conclusive. We find a Elton-ratio of 0.86, which not statistically significant on the 5 percent level. Therefore we cannot draw any conclusions from this test. Thus, we continue our study by analyzing the difference between the price adjustment on the ex-day and the dividend.

5.1 The full sample

Our objective with this thesis is to examine if there exists a so called ex-dividend day effect on the Stockholm stock exchange. Therefore we start to analyze the characteristics of the individual days in the event window. For the ex-day, the adjusted and unadjusted abnormal return and *Difference* is included. As we state in section 3.1, the adjusted abnormal return on the ex-day is adjusted for the normal return during the day, while the unadjusted abnormal return is not. The average normal daily return is equal to 0.140 percent in our sample. The results is visible in Table 3.

Table 3: The $\overline{AR}_\kappa$ for the full sample

This table shows the mean (in percent), t-statistics, standard deviation (σ), minimum value (Min), maximum value (Max) and the number of observations (N) of the Abnormal Return (AR) when the full sample is considered. κ is the day in the event window to which the AR corresponds to. The *Difference* is the difference between the dividend yield and the AR on the ex-day. The adjusted AR is adjusted for the estimated normal return during the ex-day, while the unadjusted is not. We discuss the method of adjusting the return in section 3.1. The t-statistics are calculated using the BMP method, and tests the null hypothesis that the mean is equal to 0. The test is two-tailed. The significance levels are represented by $+ = 10\%$, $* = 5\%$, $** = 1\%$, $*** = 0.1\%$.

Variable	Mean	t-statistic	σ	N
Dividend	3.241		0.018	1391
Adjusted ex-day	-2.790***	-25.600	0.066	1391
Unadjusted ex-day	-2.733***	-26.041	0.066	1391
Adjusted Difference	0.447*	2.025	0.066	1391
Unadjusted Difference	0.508**	2.648	0.066	1391
κ=-3	0.164**	2.775	0.066	1377
κ=-2	0.217**	3.169	0.066	1377
κ=-1	0.018	0.279	0.066	1380
κ=1	-0.231**	-2.995	0.066	1383
κ=2	-0.130+	-1.849	0.065	1372
κ=3	-0.223***	-3.788	0.066	1369

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3 shows that the market adjusts the share prices on the ex-day for the value lost due to the dividend. However, it does not adjust for the full dividend amount since the Adjusted *Difference* is equal to 0.447 percentage points. The price adjustment on the ex-day is then, on average, smaller than the dividend. This is statistically significant[5] on the 5 percent level. This means that there on average, at least statistically, exists a chance to earn extra profit. If an investor buys a share on the cum-day at closing price and sells as early as possible on the ex-day, he would according to the EMH not be better of than before the he bought the share. However, since the price adjustment on the ex-day actually is smaller than the dividend amount the investor makes an extra return of 0.447 percent. The following example illustrates the effect.

$$Investment = \ P_0 = 100;\ Dividend = 10;\ Dividend\,yield = 10\%$$

$$Price\,adjustment\,in\,percent = 10\% - 0.447\,percentage\,points = 9.553\%$$

$$\mathbf{ex-day\ price\ according\ to\ the\ EMH}:$$

$$P_0 * (1 - Dividend\,yield) = P_1 = 100 * 0.9 = 90$$

$$\mathbf{Return\ according\ to\ the\ EMH}:$$

$$\frac{P_1 + Dividend - P_0}{P_0} = \frac{90 + 10 - 100}{100} = 0\%$$

$$\mathbf{ex-day\ price\ according\ to\ our\ results}:$$

$$P_0 * (1 - Price\,adjustment) = P_1 = 100 * 0.90447 = 90.447$$

$$\mathbf{Return\ according\ to\ our\ results}:$$

$$\frac{90.447 + 10 - 100}{100} = 0.447\%$$

It is important to mention that we do not consider transaction costs. Also, this profit is not realized immediately since the payment of the dividend often is done roughly one week after the ex-day. However, this *Difference* is, as we state above, statistically significant on the 5 percent level, but it is very small. Even though there is a large difference between the average normal return for the period and the *Difference*, the economic significance of the result comes into question. This, together with the insignificant Elton-ratio we discuss on page 25 and the fact that we do not include transaction costs, indicates that no large ex-dividend day effect exist.

[5]Kolari and Pynnönen (2010) propose an adjustment to the BMP t-statistics which includes a variable that takes the cross-correlation of the residuals into account. We do not consider this adjustment since the specific variable is roughly equal to 1 in our sample.
$Adj.BMP = t\sqrt{\frac{1-\overline{r}}{1+(N-1)\overline{r}}}$ where $\overline{r}$ is the average cross-correlation

When studying the rest of the event window a clear pattern becomes apparent. Two out of three days prior to the ex-dividend day have statistically significant positive abnormal returns, which is in concurrence with Claesson (1987). This result can possibly be explained by investors buying shares to get the right to the dividend. It is also interesting to see that all three days after the ex-day have statistically significant negative abnormal return. This can be viewed as market adjustments of the share prices since the *Difference* is not equal to zero at the ex-day. Hence, the market appears not to be fully efficient. The results in Table 3 indicate that there is a possibility to earn a small amount of extra profit if an investor buys a share prior to the ex-day and sells on the ex-day.

Table 4: The $\overline{CAR}_{\kappa_1,\kappa_2}$ for the full sample

This table shows the mean and the standard deviation of the Cumulative Abnormal Return (CAR_{κ_1,κ_2}) for the full sample with its standard deviation is in parenthesis. The CAR_{κ_1,κ_2} is in percent. The standard deviation is calculated using equation 15 on page 15. The different symbols corresponds to t-statistics with significance levels represented by $+ = 10\%$, $* = 5\%$, $** = 1\%$, $*** = 0.1\%$. The t-statistics are calculated using the BMP method, and tests the null hypothesis that the mean is equal to 0. The test is two-tailed. κ_1 is the start day of the period, i.e the investor buys the security at close price the day before. κ_2 is the day that the period end, i.e the day the investor sells the security at close price. The $\overline{CAR}_{\kappa_1,\kappa_2}$ where $\kappa_1 = 0$ and $\kappa_2 = 0$ is equal to the Unadjusted *Difference* in table 3. The average difference between the dividend yield and the abnormal return on the ex-day is included in all $\overline{CAR}_{\kappa_1,\kappa_2}$ where the ex-day is included ($\kappa = 0$).

κ_2 \ κ_1	-3	-2	-1	0
-1	0.381** (0.114)	0.226* (0.093)	0.018 (0.066)	XX XX
0	0.872*** (0.132)	0.722*** (0.114)	0.520* (0.093)	0.507** (0.066)
1	0.622** (0.147)	0.474+ (0.132)	0.270 (0.114)	0.261 (0.093)
2	0.492+ (0.161)	0.335 (0.147)	0.132 (0.131)	0.114 (0.114)
3	0.267 (0.174)	0.107 (0.161)	-0.087 (0.147)	-0.115 (0.131)

$^{+}\ p < 0.10$, $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

It is, as we mention in sections 1 and 3, interesting to examine the $\overline{CAR}_{\kappa_1,\kappa_2}$ because it gives an indication of the efficiency of the market. From the results in Table 5.1 it appears that the market is not fully efficient when considering the full sample. Therefore we examine if the market adjust the share prices and how many days it takes.

In Table 4 the $\overline{CAR}\kappa_1, \kappa_2$, 19 different intervals are visible. As we state in section 3, $\kappa = -1$ corresponds to the cum-day and $\kappa = 0$ corresponds to the ex-day. If an investor wants to have the right to the dividend, he/she must buy shares at the latest on $\kappa = -1$. We find three intervals in Table 4 more interesting than the others. The first interval is the $\overline{CAR}_{\kappa_1,\kappa_2}$ for the period $\kappa = -3$ to $\kappa = 0$, i.e. an investor holds a share from three days prior the ex-day to the ex-day. The mean is 0.872 percent and it is statistically significant on the 5 percent level. This indicates, as we discuss earlier in this section, that there is a possibility to earn arbitrage if you buy a share three days prior to the ex-day and sell it on the ex-day if the whole sample is considered.

The second interval we find interesting is where $\kappa = -3$ and $\kappa = -1$. The mean is 0.381 percent, and it is statistically significant on the 1 percent level. This means that it is not necessary to hold the security to the ex-day to incur a profit. It is also interesting to consider the period between $\kappa = -3$ and $\kappa = -3$, i.e. the whole event window, even though it is not statistically significant.

In Table 4 it is noticeable that the $\overline{CAR}$ has a peak on the ex-day. After the ex-day, the share prices adjust downwards towards zero. Furthermore, as one can see in Table 4, it is not impossible that days further away from the ex-day (four and five days prior and after the ex-day) can affect the $\overline{CAR}$. For example, buying before $\kappa = -3$ may give the investor an even greater $\overline{CAR}$.

The results from Table 4 show that there are abnormal returns in the event period. However, they are quite small. Also, as we mention in section 2.2, the annual general meeting for many Swedish companies is on the cum-day. Therefore, we cannot be certain that the unusual price movements on the days surrounding the ex-day are explicitly caused by the ex-dividend day effect.

To earn the most money, according to our results, an investor should buy early in our event window and sell on the ex-day. In Table 4 we only use unadjusted closing prices. Using our results we can give an example. Say that an investor buys one share for 1000SEK three days prior to the ex-day and sells at closing price on the ex-day. The investor will then, in general when considering the full sample, make a profit of 8.72SEK. Similar to the ex-day return, the highest $\overline{CAR}$ is quite small.

As we have previously stated is the average normal return for the period 0.140 percent, and there is a large difference between this value and the CAR when $\kappa = -3$ and $\kappa = 0$. However, as we mention when we discuss the *Difference*, we do not consider transaction costs. It is possible that these costs can substantially decrease the abnormal return. Therefore the economic significance must be considered here as well.

5.2 Causes for the ex-dividend day effect

As we mention in section 3.4 there may exist one or several underlying causes for the difference between the dividend yield and the abnormal return on the ex-dividend day. We test if the tick size affects the *Difference* if it is not an exact multiple of the dividend. As we discuss in section 3.4, we believe that this is the most likely variable that can affect the *Difference*. We find that 312 out of 1391, or 22 percent, of the dividends in the sample is not an exact multiple of the tick size. First we perform a Hausman test to determine if the fixed effects model or the random effects model fits the data best. As can be seen in Table 8 in the appendix, it is safe to use the random effects model. This is because the χ^2 statistics calculated by Equation (20) is smaller than the critical value of the χ^2 distribution. For a full description of the Hausman test see section 3.4.

In Table 5 some of the results of the regression specified in section 3.4 are visible. We use, as we state in section 3.4, the standardized *Difference* when controlling if tick size affect the price adjustment on the ex-day. This is done because the heteroscedasticity and cross-correlation is already taken care of when standardizing the variable using the BMP t-statistics. This means that it is not necessary to adjust the dependent variable when performing the panel regression. We do find a connection between the tick size and the difference, which is statistically significant on the 5 percent level. This is in concurrence with the theory of Bali and Hite (1998) and the results of Hedman and Moll (2006). However, this does not mean that the full *Difference* is caused by the tick size. As we have mentioned previously factors such as the annual general meeting can affect the ex-dividend day effect.

Table 5: Tick size regression

This table shows the result of the regression with the standardized adjusted difference between the dividend yield and the abnormal return on the ex-day as dependent variable and the tick size dummy as independent variable. The t-statistics is in parenthesis tests the null hypothesis that the coefficient is equal to 0. The significance levels are represented by $+ = 10\%$, $* = 5\%$, $** = 1\%$, $*** = 0.1\%$.

	(1) Standardized Difference
Tick Size Dummy	0.445^{**}
	(2.59)
Constant	0.0461
	(0.57)
Observations	1391

t statistics in parentheses

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5.3 The results considering the years individually

When analyzing the years individually we choose three variables we find interesting. The main objective of this thesis is to examine if there exists a so called ex-dividend day effect on the Stockholm stock exchange. Therefore we analyze the yearly *Difference*. We also include two different $\overline{CAR}_{\kappa_1,\kappa_2}$'s. We choose the period where $\kappa_1 = 3$ and $\kappa_2 = 1$. This period is chosen because Table 4 show that it is possible to make an abnormal profit without the right to the dividend. We also choose the period where $\kappa_1 = -3$ and $\kappa_2 = 3$. This is because we want to examine the whole event window.

When studying Table 6 it becomes clear that the ex-dividend day effect is not that common. Only five out of twelve years show a difference that is statistically significant between the dividend yield and the abnormal return on the ex-dividend day, and only two years are significant on the 5 percent level.

Table 6: Yearly adjusted difference on the ex-dividend day

This table shows the mean (in percent), the standard deviation (σ) and the t-statistics of the adjusted difference between the abnormal return on the ex-day and the dividend yield for each individual year. It also includes the number of observations (N) and the minimum (Min) and maximum (Max) value of each year. The t-statistics are calculated using the BMP method. The null hypothesis tested is that the mean is equal to 0. The test is two-tailed. The significance levels are represented by $+ = 10\%$, $* = 5\%$, $** = 1\%$, $*** = 0.1\%$.

Year	Mean	Min	Max	σ	t-statistics	N
2000	1.273*	-8.250	13.945	0.341	2.131	83
2001	0.348	-37.686	34.942	0.329	-0.682	89
2002	2.209***	-8.678	21.662	0.339	3.703	84
2003	1.004	-10.721	9.883	0.341	1.488	83
2004	0.339	-13.936	10.223	0.324	-0.360	92
2005	-0.197	-13.105	10.102	0.300	-0.890	107
2006	0.389^{+}	-12.610	11.509	0.276	1.905	127
2007	0.912**	-11.990	10.022	0.262	3.145	141
2008	-0.119	-15.621	19.173	0.249	-0.304	155
2009	-0.521^{+}	-16.693	18.307	0.270	-1.769	132
2010	0.912	-14.438	29.621	0.260	1.104	143
2011	-0.097	-18.915	9.610	0.249	-0.446	155

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

To control the robustness of the our results, the minimum and the maximum value are included in Table 6. It seems like, at least for year 2002 and 2010, that the high abnormal return these years are due to large positive outliers because the absolute difference between the minimum and maximum value is large. The opposite holds for year 2011, i.e. it seems like the negative abnormal return can be affected by a large negative outlier. The absolute difference for the other years is not that large, therefore they are more difficult to interpret. Since the absolute difference for most of the years is small, the comparison indicates that the original data have means that reflect the data well.

Table 7: Yearly $\overline{CAR}_{\kappa_1,\kappa_2}$

This Table displays, for two different $\overline{CAR}_{\kappa_1,\kappa_2}$'s, the mean (in percent), standard deviation (σ), the t-statistics and the number of observations (N) for each individual year in the sample. The standard deviation is calculated using equation 15 on page 15. The t-statistics are calculated using the BMP method and tests if the null hypothesis of the mean equal to 0 is true. The significance levels are represented by $+ = 10\%$, $* = 5\%$, $** = 1\%$, $*** = 0.1\%$. κ_1 is the start day of the period and κ_2 is the day that the period end.

(a) $\boldsymbol{\kappa_1 = -3}$ $\boldsymbol{\kappa_2 = 3}$

Year	Mean	t-statistics	σ	N
2000	1.979^{+}	1.867	0.915	81
2001	0.734	0.035	0.817	84
2002	2.362^{**}	3.380	0.592	78
2003	0.983	1.388	0.571	72
2004	0.017	-0.532	0.418	90
2005	-0.221	-0.600	0.431	105
2006	0.479	0.635	0.382	124
2007	1.46^{*}	2.553	0.351	141
2008	-1.207	-1.61	0.481	152
2009	-0.269	-0.719	0.825	131
2010	-0.319	-0.502	0.423	142
2011	-0.616	-0.972	0.743	154

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(b) $\boldsymbol{\kappa_1 = -3}$ $\boldsymbol{\kappa_2 = -1}$

Year	Mean	t-statistics	σ	N
2000	1.753^{**}	3.327	0.346	81
2001	0.037	0.511	0.310	88
2002	0.429^{+}	1.911	0.223	79
2003	0.311	0.926	0.263	76
2004	0.255	0.562	0.157	91
2005	0.545	0.745	0.162	107
2006	1.161^{*}	2.160	0.144	126
2007	0.815^{+}	1.871	0.133	141
2008	-0.454	-0.818	0.181	153
2009	0.246	0.454	0.310	132
2010	-0.137	0.253	0.159	143
2011	0.215	0.455	0.281	154

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The yearly $\overline{CAR}_{\kappa_1,\kappa_2}$'s for the periods $\kappa_1 = -3$ to $\kappa_2 = 3$ and $\kappa_1 = -3$ to $\kappa_2 = -1$ show that abnormal returns on the days surrounding the ex-day are not a common occurrence. Based on Table 7a and 7b, only two years have a statistical significant abnormal return at the 5 percent level. These years are not the same in the two tables, which indicate there is no obvious connection between the abnormal return prior to the ex-day and the abnormal return after the ex-day. Therefore it seems that the market is, at least partly, efficient on the days surrounding the ex-day.

6 Summary and Conclusion

In this study we examine the ex-dividend day effect on the Stockholm stock exchange (SSE). The price movements of the SSE on the days surrounding the ex-day are also examined. We use event study methodology with a statistical test that takes that the variance increase around the ex-day into account. The test also takes clustering of the ex-days into account. Our estimation period consist of 30 days to ensure that the distribution follow the standard normal. We study a period of three days prior to the ex-day and three days after the ex-day which gives a event window of seven days. The sample consists of 1391 dividends in the period 2000 to 2011. We control for an ex-dividend day effect both in the full sample of 12 years and each individual year. We use prices that are adjusted for the expected return on the ex-day. This is necessary since closing prices are used. This is done to separate the price movements that are caused by the separation of the right to the dividend from the share.

We find an Elton-ratio of 0.86 for the full sample, which is not statistically different from 1 on the 5 percent level. These results indicate that an ex-dividend day effect on the SSE is not a common occurrence. This is in concurrence with Elton and Gruber (1970). They state that in a country like Sweden, with equal taxes on capital gains and dividends, the Elton-ratio should equal 1.

However, when we analyze the difference between the dividend yield and the CAPM estimated abnormal return on the ex-day for the full sample, we find that this difference is statistically significant at the 5 percent level. According to this result, there exists a possibility to earn money on the ex-day, i.e. there actually exists an ex-dividend day effect on the SSE. We find that if an investor buy a share at closing price on the cum-day and sell as quickly as possible on the ex-day, he can on average earn an abnormal return of 0.447 percent. However, it is important to note that in this value the actual dividend payment is considered. The payment of the dividend is not completed until roughly one week after the ex-day, so the profit is not acquired directly. We also do not consider transaction costs, so the results are, even though statistically significant, probably not economically significant for a normal investor. Also, only a few of the individual years have a statistical significant difference between the abnormal return on the ex-day and the dividend yield. This, together with the small difference between the abnormal return on the ex-day and the dividend yield when the full sample is considered, indicates that an ex-dividend day effect is not a common occurrence on the SSE.

We also find that the days surrounding the ex-dividend day exhibit unusual price movements when the full sample is considered. The biggest profit can be made if an investor buys the share three days prior to the ex-dividend day and sells it on the ex-day. As with the average profit on the ex-day, the average profit in this period is quite small. Therefore, the economic significance of the result come into question.

Based on previous research we investigate if the market is inefficient or if the ex-dividend day effect is caused by that the dividend is not an exact multiple of the tick size. We find statistical evidence that the tick size is a reason for the discrepancy when the full sample is considered. This is in concurrence with e.g. Bali and Hite (1998) and Hedman and Moll (2006). Therefore we cannot reject the Efficient Market Hypothesis.

In the introduction we state three research questions and we answer them by combining our different results to answer them. The first question asks if there exists a difference between the dividend yield and the abnormal return on the ex-day. Since we do not find any strong statistical and economical evidence that supports the existence of an ex-dividend day effect on the SSE, we cannot conclude that it does exist. This is in concurrence with Claesson (1987), but it contradicts the results of Hedman and Moll (2006).

The second research question asks if the days surrounding the ex-day have normal returns. This question indirectly asks if the market is efficient. This is also true for the third research question. It asks if there exist underlying causes for a possible ex-dividend day effect. Regarding the second research question, we find similar results to the first research question, i.e. no strong statistical and economical evidence that support the existence of abnormal returns during the days surrounding the ex-day. The answer to the third research question is that we do find statistical evidence that indicates that the tick size can be an underlying cause if the ex-dividend day effect occurs. Therefore, we cannot conclude that the market is inefficient.

6.1 Suggestions for further research

Since we have not considered to transaction costs in our sample, it would be interesting to examine if transaction costs really is a factor to consider. Maybe these costs can be ignored, due to low levels, and thus it does not have a significant impact on the price adjustment. Also, many of the cum-days on the SSE occur at the same day as the annual general meeting. This can affect the ex-day price of the share. As further research, it would be interesting to investigate how the annual general meeting is affecting the share prices on the ex-day, since an impact on the ex-day prices will of course have an effect on such studies as ours.

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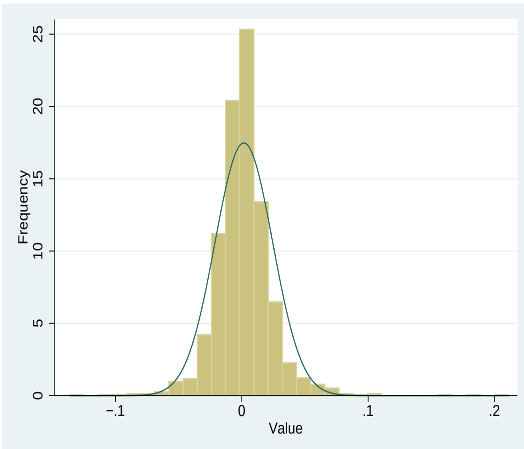
A Appendix

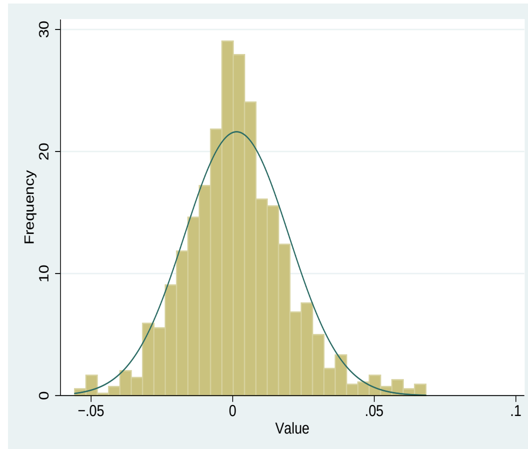
Figure 4: Histograms for the days prior to the ex-dividend day

This figure shows the distribution of the abnormal returns in relation to the standard normal distribution.

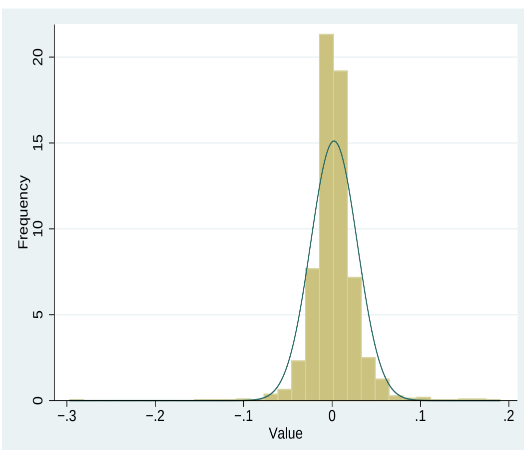
(a) $\kappa = -3$ Full sample



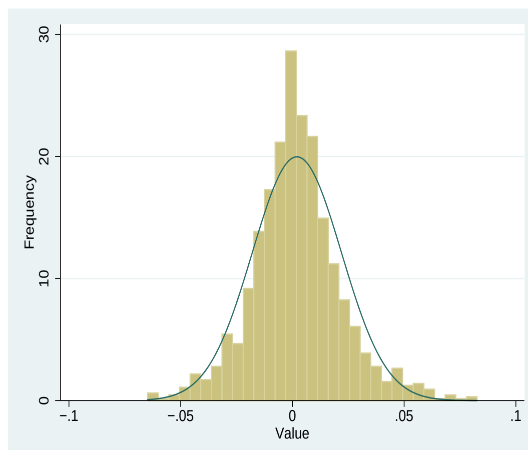
(b) $\kappa = -3$ Trimmed



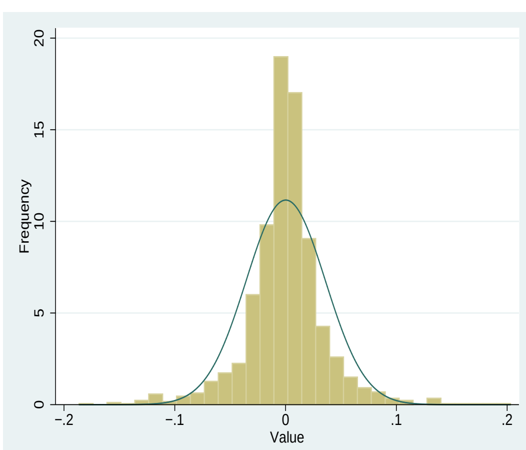
(c) $\kappa = -2$ Full sample



(d) $\kappa = -2$ Trimmed



(e) $\kappa = -1$ Full sample



(f) $\kappa = -1$ Trimmed

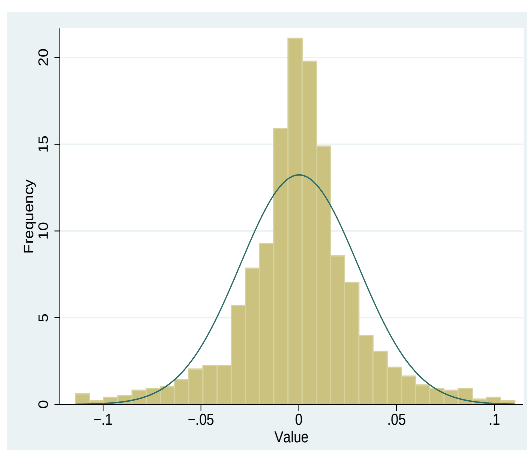
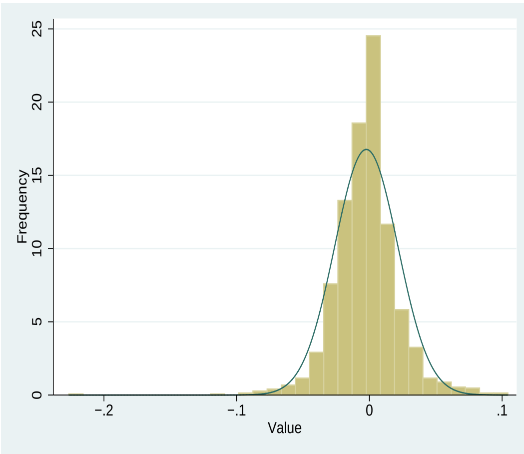


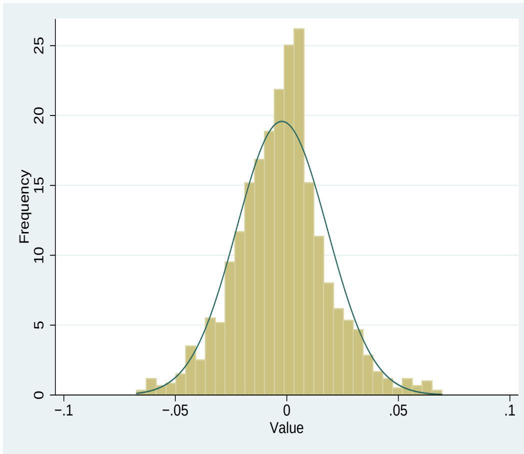
Figure 5: Histograms for the days after the ex-dividend day

This figure shows the distribution of the abnormal returns in relation to the standard normal distribution.

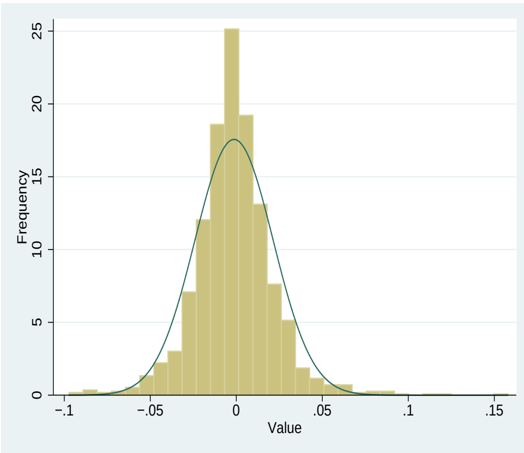
(a) $\kappa = 1$ Full sample



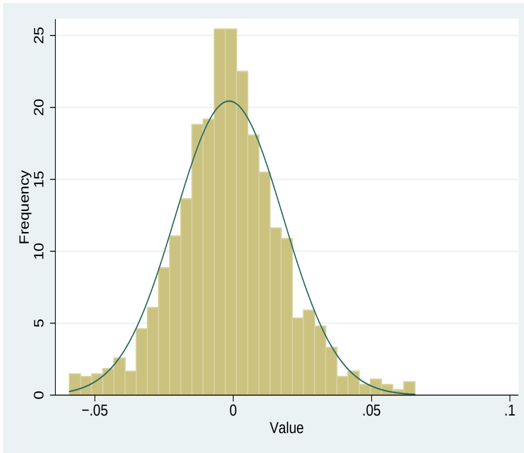
(b) $\kappa = 1$ Trimmed



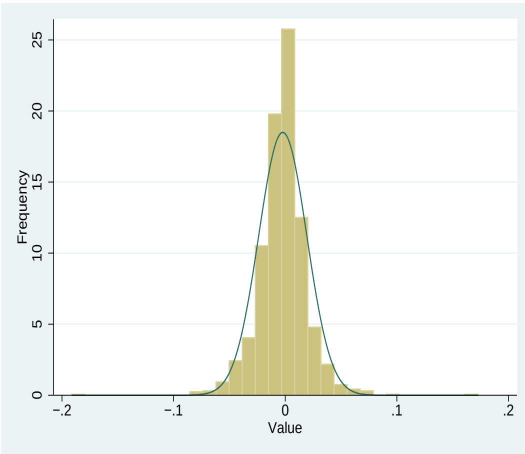
(c) $\kappa = 2$ Full sample



(d) $\kappa = 2$ Trimmed



(e) $\kappa = 3$ Full sample



(f) $\kappa = 3$ Trimmed

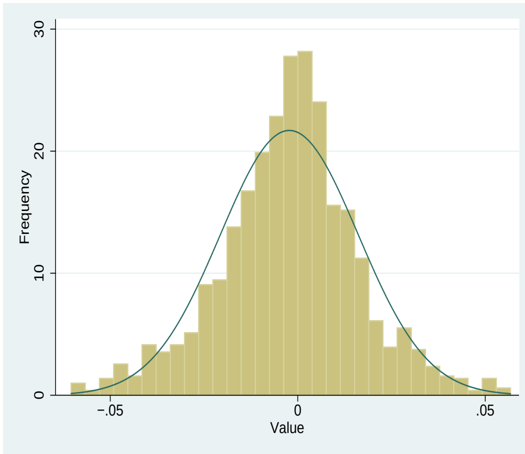


Table 8: Hausman test

	–Coefficients–			
	$(\hat{\beta}_{FE})$	$(\hat{\beta}_{RE})$	$(\hat{\beta}_{FE}-\hat{\beta}_{RE})$	$\mathrm{sqrt}(\mathrm{diag}(\hat{V}\{\hat{\beta}_{FE}\}-\hat{V}\{\hat{\beta}_{RE}\}))$
	Fixed	Random	Difference	S.E.
Tick size dummy	0.4600416	0.4452281	0.0148135	0.1483231

$\hat{\beta}_{FE}$ = consistent under the null hypothesis and the alternative hypothesis.
$\hat{\beta}_{RE}$= inconsistent under the alternative hypothesis, efficient under the null hypothesis
H_0: difference in coefficients is not systematic

$\chi^2(1) = \xi_H = (\hat{\beta}_{FE}-\hat{\beta}_{RE})'[\hat{V}\{\hat{\beta}_{FE}\}-\hat{V}\{\hat{\beta}_{RE}\}]^{-1}(\hat{\beta}_{FE}-\hat{\beta}_{RE}) = 0.01$

Prob> $\chi^2 = 0.9204$

Table 9: Companies (shares) included in the study

Alfa Laval	Peab B	BioGaia B	NIBE Industrier B	DGC One	OEM International B
Assa Abloy B	Ratos B	Björn Borg	Nobia	DORO	Partner Tech
Atlas Copco B	SAAB B	Brinova Fastigheter B	Nolato B	Duroc B	Phonera
Atrium Ljung	Sandvik	Bure Equity	Nordnet B	Elanders B	Poolia B
Axfood	SCA B	Byggmax Group	Proffice B	Electra Gruppen	Prevas B
Boliden	Scania B	Clas Ohlson B	Rezidor Hotel Group	Elos B	Pricer B
Castellum	SEB A	Corem Property Group	Sagax	Enea	Proact IT Group
Electrolux B	Securitas B	Diös Fastigheter	SkiStar B	eWork Scandinavia	Probi
Elekta B	Skanska B	Duni	Swedol B	Feelgood Svenska	Profilgruppen B
Ericsson B	SKF B	East Capital Explorer	Systemair	FormPipe Software	RaySearch Laboratories B
Fabege	SSAB B	Eniro	TradeDoubler	Geveko B	ReadSoft B
Getinge	Stora Enso A	Fagerhult	Unibet Group	Havsfrun Investments B	Rederi AB Translatic
Hakon Invest	Sv. Handelsbanken B	Fast Partner	Wihlborgs Fastigheter	Hemtex	Rejlerkoncernen
Hennes och Mauritz	Swedbank A	Fast. Balder B	ÅF B	HMS Networks	RNB RETAIL AND BRANDS
Hexagon B	Swedish Match	Fenix Outdoor B	Öresund	I.A.R Systems Group	Rottneros
Holmen B	Tele2 B	Gunnebo	Acando B	Intellecta B	Rörvik Timber B
Hufvudstaden A	Telia Sonera	Haldex	ACAP Invest B	ITAB Shop Concept B	SECTRA B
Husqvarna B	Tieto OYJ	HEBA B	Addnode B	Jeeves Information Systems	Sensys Traffic
Industrivrden	Trelleborg B	HEXPOL B	AllTele	KABE B	Sigma B
Investor B	Wallenstam B	HiQ International	Avega Group B	Know IT	SinterCast
Kinnevik B	Volvo B	Höganäs B	Beijer Electronics	Lagercrantz Group B	Softronic B
Latour B	AarhusKarlshamn	Industrial ans Financial Syst. B	Bergs Timber B	Lammhults Design Group B	Stj¨rnaFyrkant AB
Lundbergfretagen	Addtech B	Indutrade	Biotage	Micro Systemation B	Studsvik
Lundin Mining	Avanza Bank Holding	Intrum Justitia	Bong	Midsona B	Svedbergs B
Meda A	Axis	JM	BTS Group B	Midway B	Svolder B
Melker Schörling	B and B TOOLS B	KappAhl	Catena	MQ Holding	Traction B
Millicom Int. Cellular	BE Group	Klövern	CellaVision	MSC Konsult B	Transcom Worldwide SDB B
Modern Times Group B	Beijer Alma B	Kungsleden	Concordia Maritime B	Nederman Holdning	Uniflex B
NCC B	Beijer B	Lindab International	Connecta	NOTE	VBG GROUP B
Nordea Bank	Betsson B	Loomis B	Consilium B	Novestra	Venue Retail Group B
Oriflame	Bilia A	Mekonomen	Cybercom Group	NOVOTEK B	Vitrolife
SDB	Billerud	New Wave B	Dagon	Odd Molly International	XANO Industri B