Ex-dividend day price behaviour on the Stockholm Stock Exchange
- An empirical study of the Stockholm Stock Exchange 2001-2005

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ABSTRACT

How is a company's share price adjusted on the day when the dividend right is separated? For the current institutional setting, we find that the price ratio is on average less than one on the Stockholm Stock Exchange. Our study thus confirms that differential taxes cannot fully explain the ex-dividend day share price behaviour. We identify three main factors, besides taxes, that investors take into account when they trade around the ex-dividend day. First, investors seem to value the potential gains from dividend-capturing trading lower than the risks associated with lower dividend yield shares. Second, we have found evidence that price discreetness significantly lowers the price ratio. Third, transaction costs lower the efficiency of the price ratio. For investors on the Stockholm Stock Exchange there are two main implications of our study: i) the ex-dividend day share price adjustment is efficient when noise, firm-specific risks and trading costs are considered, ii) there are no risk-adjusted benefits on average from dividend-capturing trading in shares; however, there could still be opportunities for arbitrage profits by trading in derivatives which are priced using an implied price ratio of one.

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1 INTRODUCTION

What happens to a company's share price on the day when the dividend right is separated? Empirical studies on international data have provided strong evidence that the average decline in the share price is less than the dividend amount. In our study, which is the first to investigate the ex-dividend day share price behaviour on the Stockholm Stock Exchange for the current institutional settings, we aim to investigate and explain why the ex-dividend day adjustment deviates from the theoretical prediction.

Understanding the nature of the Stockholm Stock Exchange ex-dividend day share price behaviour is important because it relates to several topics in applied finance. First, dividends represent a stable and relatively large source of investment returns for investors and it is therefore essential to understand how to calculate and forecast the impact from dividend payments. Second, the listed companies need to appreciate how their dividends are valued by the market in order to choose the most efficient form of profit distribution. Third, the dividend adjustment is especially acute for derivatives valuation when there is a dividend before the maturity of the instrument. In the Black and Scholes formula as presented in Hull (2003), derivatives on dividend-paying shares are generally priced using the assumption that the market valuation of the share is adjusted downwards by the full value of the dividend. Hence, if this relationship does not hold, there could be an arbitrage opportunity. Finally, if the share prices on the Stockholm Stock Exchange do not adjust according to theory, this could be an indication of market inefficiency or theory incompleteness.

The Swedish institutional setting provides an excellent opportunity to investigate the ex-dividend day share price behaviour. Due to the Swedish practice of paying dividends on a yearly basis, compared to, for example on a quarterly basis in the US, the dividends tend to represent a larger fraction of the total share value on each specific occasion. Further, the relatively homogenous Swedish tax structure simplifies the calculation of the theoretically correct share price adjustment. Consequently, the Stockholm Stock Exchange should provide a good foundation for testing the theoretical implications empirically.

1.1 PURPOSE AND CONTRIBUTION

The purpose of this thesis is threefold. First, we investigate previous research and establish a theoretical prediction of how the ex-dividend day price adjustment on the Stockholm Stock Exchange currently should behave. Second, we make a descriptive analysis of the empirical ex-dividend day price adjustment using recent Swedish data. Third, we analyse the factors driving the empirical price adjustment.

The contribution of our thesis is twofold. First, we construct three unique datasets, containing comprehensive data for the period 2001-2005 of the empirical dividend price adjustments, the abnormal trading during the dividend period and the share price momentum around the dividend period. Second, we perform analyses of the main drivers influencing the ex-dividend day price adjustments on the Stockholm Stock Exchange, including the momentum variable, which has not been used in this context before.

1.2 OUTLINE

We begin our thesis by developing a theoretical framework for our study and detailing the specific Swedish institutional setting in order to understand how the ex-dividend price adjustments should theoretically behave on the Stockholm Stock Exchange. Based on the theoretical framework we develop our hypotheses regarding the Swedish ex-dividend adjustment. Thereafter we present our data and the methods we use, followed by a presentation of the empirical findings of our study using both a univariate and multivariate analysis. The final part of our thesis concludes with a discussion of our findings and suggestions for further research.

2 THEORETICAL FRAMEWORK

In this section we first present the basic metric and terminology we use throughout our study to investigate the ex-dividend day share price behaviour on the Stockholm Stock Exchange ('SSE'). Second, we outline the four main explanations of the ex-dividend share price adjustment. Third, we factor in the specific Swedish institutional setting and investigate how this compares to the institutional settings in previous studies and how this should affect the overall results of our study.

The metric we use to infer how investors value the dividend right, is called the ex-dividend day share price ratio ('price ratio'). This metric is designed to explain the price ratio, and was initially defined by Elton and Gruber (1970). The idea behind their study was that investors have a choice to buy or sell the share with or without the right to the dividend. The last day the share is traded with this right to receive the dividend is called the cum-dividend day ('cum-day') and the first day when the shares are traded without the right to the dividend is called the ex-dividend day ('ex-day'). Their idea was that one can investigate the share price adjustment between these two days to understand how the marginal investor values the dividend. In an efficient market the value of the share on the cum-day should equal the value of the share on the ex-day plus the value of the dividend. If this is not satisfied there would be an arbitrage opportunity, which should be traded away in an efficient market. A study of the ex-day price adjustment should be able to reveal how dividends are valued by the marginal investor in any given stock market. We denote the dividend price adjustment as the 'ex-day share price behaviour'.

The price ratio used in their study is a measure of how large the adjustment of the share price is on the ex-day compared to the size of the dividend. The variable is defined as follows, where S_{t-1} is the share price on the cum-day, S_t is the share price on the ex-day and Div_t is the size of the dividend:

$$PR = \frac{(S_{t-1} - S_t)}{Div_t} \qquad (1)$$

Our main purpose of this study is to document and understand how the price ratio behaves on the SSE. In the following sections we present the three main causes of the empirical price ratios suggested by theory – the differential taxes, price discreetness, bid-ask bounce and our new share price momentum explanation.

2.1 DIFFERENTIAL TAXES EXPLANATION

Profit distributions to shareholders primarily take the form of either a cash dividend or a share buyback, even though more complex tax-motivated schemes are becoming increasingly common. In our study this is an important distinction as the effects on the share price following a dividend payment or a share buyback might potentially be different. When a company distributes cash via a dividend the value of the company decreases, but the number of shares remains the same and hence the value per share should decrease. In the case of a share buyback the value of the entire company decreases as much as in the case of a dividend distribution, but the number of shares also decreases. The combined effect, if the shares are bought back at market prices, is that the value per share is unaffected by the buyback. In our study we focus on cash dividends, but we have also included distributions of shares in listed subsidiaries.

Under many tax regimes, taxes on dividends and taxes on capital gains are different. This should have implications for how the marginal investor values a dividend since the investor potentially gives up capital gains for a dividend and hence face a different tax bracket. The first important study of this tax effect on the price ratio was the Elton and Gruber study from 1970, which found an empirical relationship between the price ratio and the marginal investors' tax rates for US data. The relationship is expressed in equation 2, where t_0 is the tax rate on dividend income and t_C is the tax rate on capital gains:

$$\frac{(1-t_0)}{(1-t_c)} = \frac{(S_{t-1} - S_t)}{Div_t} \qquad (2)$$

The argument behind equation 2 is that the price ratio in an efficient market should be such that the marginal investor is indifferent between buying and selling on either the cum- or ex-day. Therefore the following relationship, where S_x is the purchase price of the share, S_t is the price on the ex-day and S_{t-1} is the price on the cum-day, should hold:

$$S_{t-1} - t_c \cdot (S_{t-1} - S_x) = S_t - t_c \cdot (S_t - S_x) + Div_t \cdot (1 - t_0) \qquad (3)$$

The left side is the cum-day price less the latent tax on the capital gain or loss to date. In an efficient market this must equal the right hand side, the ex-day share price less the remaining after-tax capital gain (loss) plus the after-tax value of the dividend. The rationale is that the value of the share to the investor the day before the dividend right is separated must be equal to the after-tax value of the share and the dividend the day after the dividend right is separated.

Rearranging equation 3 we get equation 2, a simple expression for the theoretical share price reaction on the ex-day to account for differential tax treatment. If for example the marginal investor pays higher taxes on dividends than on capital gains, as was the case in the US at the time for the Elton and Gruber (1970) study, the price ratio should be less than one. The argument is that the marginal investor would value the sum of the dividend and the ex-dividend share lower than the cum-day share because of the preferential tax treatment of capital gains. Elton and Gruber (1970) empirical study showed that the average price ratio on the New York Stock Exchange (‘NYSE`) in the two years of the study, from April 1966 to March 1967, was 0.78. This meant that the probability that their statistic was one or more, i.e. at least an ex-day adjustment by the full dividend amount, was less than 1.5 %. It should be noted, however, that equation 3 implies that the investor can get a full tax refund on the whole capital loss caused by the ex-day price adjustment. This might not always hold in real life settings, normally an investor can only match parts of his or her losses against earlier (taxable) gains during a specific taxation period. Therefore the tax effect on the ex-day pricing could be weaker than implied by equation 2.

The Elton and Gruber (1970) study and the tax explanation they suggested have gotten recent support by, among others, Green and Rydqvist (1999) and a recent study by Elton et al performed in 2005. The Elton et al (2005) study shows that the average price 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 one as suggested by equation 2 above.

Barclay (1987) measured the average price ratio on the NYSE before the introduction of federal income tax and found that it was not significantly different from one. It is noteworthy that, just as Frank and Jagannathan (1998) mentioned below, the Barclay (1987) study concerns a setting where capital gains and dividends are taxed at the same rate. Hence, it is not the absence of taxes per se but rather the absence of *differential* taxes that is important, as this causes investors in the pre-tax period to value dividend payments and capital gains as perfect substitutes.

Another study related to the tax explanation is Lakonishok and Vermaelen (1986), which investigated the existence of tax-induced trading around the ex-day for NYSE and AMEX companies from 1970 to 1981. They find that there is a significant increase in volume during the ex-dividend period, which they consider to be evidence that short-term traders have an impact on the ex-day price behaviour. Hence, their findings support the idea that trading occurs in connection to the ex-day to make the price adjustments efficient for the marginal investor.

2.2 PRICE DISCREETNESS EXPLANATION

There are several studies that suggest other explanations to the empirically observed price ratios in addition to the tax explanation. One of the more notable is the Bali and Hite (1996) working paper and the subsequent Bali and Hite (1998) article that identifies two market microstructure based explanations of the empirical finding that the price ratio often deviates from what is predicted by the tax hypothesis. The first explanation builds on the effect of price discreetness.

Bali and Hite (1998) argues that tick sizes cause a valuation problem for the investor when the dividend payment is not an exact multiple of the tick size. They argue that this causes the price ratio to be less than the dividend amount. The impact is, however, limited to one tick, as the marginal investor is assumed to round the price ratio downwards when the dividend is not equally divisible with the tick size. This to avoid having to pay a price greater that the dividend amount. They found that the price ratio approaches one when the ratio of tick size to dividend decreases. Based on this finding they argue that the tax explanation is not the only possible conclusion to draw from the empirical data and also points out that it will be difficult to distinguish between the effect from differential taxes and the impact of tick sizes in empirical data.

The recent Graham et al (2003) study investigates the effect of price discreetness by looking at reductions in tick sizes on the NYSE. Their results indicate that there is a significant reduction in the median price ratio from the 1/8 tick size era to the 1/16 era and from the 1/16 era to the decimal era. However, they find no significant reduction in the average price ratio, which might be due to extreme outcomes or outliers.

2.3 BID-ASK BOUNCE EXPLANATION

The second explanation offered by Bali and Hite (1998) is that differential trading preferences between different investor types will cause the share price to be artificially depressed on the cum-day and artificially enhanced on the ex-day. They illustrate this by building a stylised model of a market with three different trader types; buyers, sellers and arbitrageurs. The arbitrageurs are defined as professional investors who face symmetric tax rates on short-term gains (losses) and dividend income. The buyers and sellers are assumed to trade only on exogenous factors and, if these factors make them want to trade during the dividend period, they only have to choose whether to trade on the cum- or ex-day. The preferential tax treatment and a higher proficiency in handling the dividend give arbitrageurs a comparative advantage compared to other market actors. Therefore it is assumed that buyers and sellers will avoid owning the share at the close of the cum-day. As a result, the buyers that are in the market around the ex-day tend to buy at the ex-day and the sellers tend to sell at cum-day. This behaviour causes what Bali and Hite (1998) calls a 'bid-ask bounce', where the share price is first depressed on the cum-day and then boosted on the ex-day as large volumes are sold at the bid price during the cum-day and large volumes are bought at the ask price during the ex-day. Note that it is the *distribution* of bid and ask trades during these days that is abnormal and that the bid-ask bounce effect does not imply that the total trading volume must be abnormal around the ex-day. The empirical implication of this is that the price ratio is distorted by the value of the spread, since the dividend-motivated sellers pay the spread on the cum-day and the dividend-motivated buyers pay the spread on the ex-day. However, since the distribution of dividend-motivated buyers and sellers are unknown it is plausible that the empirical effect from the dividend motivated trades is lower than one spread, as noise traders and other non dividend-motivated traders, also trade around the ex-day.

One of the more notable studies of the bid-ask bounce effect is the Frank and Jagannathan (1998) study of the ex-day price behaviour on the Hong Kong Stock Exchange ('HKSE') for the period of 1980-1993. On the HKSE the price ratio suggested by equation 2 is one, since there are no taxes on either capital gains or dividend income. Contradictory to this they find an average price adjustment of only HK$0.06 during this period, when the average dividend was HK$0.12. This suggests that there are other determinants of the price ratio than just differential taxes and Frank and Jagannathan (1998) suggests the bid-ask effect as the primary explanation for their findings.

2.4 MOMENTUM EXPLANATION

The relationship between share price momentum around the ex-day and the ex-day share price behaviour has not been investigated in any previous studies that we are aware of. The impact from share price momentum should be to distort the price ratio from the theoretical correct value according to the differential taxes explanation. If the share price has a significant positive or negative trend before the ex-day, it is possible that this trend could persist on the ex-day. If this is the case, then the price ratio should be positively or negatively distorted. For a positive momentum the share price should decrease by less than the full amount of the dividend on the ex-day (price ratio distorted downwards) and for a negative momentum, the share price should decrease by more than the full amount of the dividend on the ex-day (price ratio distorted upwards).

2.5 THE SWEDISH INSTITUTIONAL SETTING

The institutional setting in Sweden should impact the price ratios on the SSE. Dividends in Sweden are paid on a yearly basis, compared to quarterly on for example the US stock exchanges. This implies, given that the average dividend yield is similar in the different markets, that each dividend on the SSE gets relatively more attention from market participants. The effects of this practice on the price ratio are multifaceted. First, the greater importance of the dividend enforces the predictions from the differential tax explanation since market actors should be more concerned about the dividend. Second, the increased magnitude of the dividend compared to the tick size and the spread should reduce the impact from the price discreetness and bid-ask bounce effects. Given the unusually high dividend yields on the SSE the price ratios should better conform to the predictions based on the differential taxes explanation.

It is customary for public Swedish companies to place the ex-day on the day after the Annual General Meeting ('AGM'), which introduces a problem for studies of the empirical price ratio. If material information, for example new management guidance, is released at the AGM the price adjustment on the ex-day might be driven by other factors than purely the separation of the dividend right. Further, since the AGM of Swedish companies technically has to approve the suggested dividend amount and record day there is always some degree of uncertainty about the parameters of the dividend on the cum-day. Because of the concentration of the majority of the AGMs and hence dividend payments in the spring, the SSE tend to be more volatile than usual during this time, causing potential noise to any empirical study of the price ratio.

These specific uncertainties for Swedish companies combined with the general uncertainties for a dividend capturing trader means that there is always some risk involved in the trade that cannot be hedged. The overnight position also involves an un-diversifiable firm-specific risk for the trader, for example the release of new material information. These risks will limit the efficiency of the market and increases the risk of an imperfect adjustment on the ex-day. This should be especially acute for smaller, highly volatile shares with low dividend yields.

The tax treatment of different investors in Sweden defines a couple of investor groups. An exhaustive account of the tax rules concerning all investor groups is not meaningful for our purpose. What is interesting for our study regarding the price ratio is to identify the parameters for the marginal investor, who will be the price setter in the dividend-capturing trading. We believe that these marginal investors will be the large professional arbitrageurs active on the SSE, mainly the trading divisions of the largest Swedish investment banks and trading firms, and to some extent also the larger international investment banks and arbitrageurs. These incorporated investors are, according to Lodin et al (2005), allowed to deduct capital losses from gains within the same fiscal year and deduct the operating costs against the net capital gain for the fiscal year. For a foreign investor the final tax rate on dividends and capital gains depends on their home country's tax regime and potential double-taxation agreements with Sweden. Investors incorporated in Sweden are taxed using the Swedish corporate tax rate of 28%.

Therefore it can be concluded that the tax rates on capital gains and dividend income are the same for the marginal investors under the current Swedish tax regime, which implies a price ratio of 1 using equation 2. This seems to be consistent with the general view among professionals involved in the Swedish financial industry. Among them is Peter Malmqvist (Dagens Industri, 2006, February 7), head of research at Nordnet who commented on the topic in a recent article and claimed that the share price should adjust for the full amount of the dividend on the ex-day. Further, Mats Sjölin, an arbitrageur who we interviewed was of the same opinion.

No studies have investigated the current Swedish institutional setting and its impact on the price ratio. Two studies that have been performed using Swedish data are Green and Rydqvist's (1999) who studied the ex-day behaviour of Swedish lottery bonds as described above and Daunfeldt (2002) who investigated the SSE during 1988-1995. Green and Rydqvist (1999) studied the ex-dividend price behaviour of Swedish lottery bonds. The tax explanation predicts that these should have a price ratio above one, because coupon payments are only taxed with 20% lottery taxes while capital gains are taxed at a higher rate. The results are consistent with the tax argument in Elton and Gruber (1970) as the authors find an average price ratio of 1.3. Daunfeldt (2002) found in his study the average price ratio was both below one and below what was predicted by the differential tax hypothesis.

Table 2.5.1: Summary of previous research and findings

Authors	Main findings relevant for our study	Implications for the price ratio in the Swedish case
Differential taxes		
Elton and Gruber (1970)	• The marginal investor's differential tax rates determine the share price adjustment on the ex-day	PR = 1
Elton et al (2005)	• Reaffirms the results from the original 1970 study using recent US data	PR = 1
Green and Rydqvist (1999)	• Provides evidence of the differential taxes hypothesis on recent Swedish lottery bonds data	PR = 1
Barclay (1987)	• Cannot reject that PR=1 on US data from before the introduction of federal taxes	PR = 1
Lakonishok and Vermaelen (1986)	• Provides evidence of an abnormal increase in volume during the ex-dividend period on US data	PR = 1
Daunfeldt (2002)	• Fails to reject that changes in the Swedish differential taxes ratio have any significant effect on the price ratio • Rejects the hypothesis that PR = 1 for Swedish data	PR ≠ 1
Market microstructure		
Bali and Hite (1998)	• Suggests that the price discreetness of dividends lowers the price ratio when the dividend is not an exact multiple of the tick size • Suggests that the bid-ask bounce adds to lowering the price ratio below the prediction of the differential taxes hypothesis	PR < 1
Frank and Jagannathan (1998)	• Supports the results of Bali and Hite using data on the Hong Kong Stock Exchange	PR < 1
Graham et al (2003)	• Concludes that the average price ratio moved further from the prediction as tick sizes decreased on the NYSE, contrary to the prediction by the price discreetness hypotheses	PR < 1

3 HYPOTHESES

We derive our hypotheses from our theoretical framework with some modifications based on the specific Swedish institutional settings. Most importantly, we contribute to the research on the ex-day share price behaviour by adding a new hypothesis which, to the best of our knowledge has not been investigated before - the share price momentum around the ex-day.

3.1 DIFFERENTIAL TAXES HYPOTHESES

Under the differential taxes explanation, the price ratio on the ex-day should be driven by the marginal investor's differential taxes on capital gains and dividends as formulated by equation 2 above. Hence, in the specific Swedish institutional setting where we have identified the marginal investor to have equal capital gains and dividend taxes the price ratio should equal one. More technically, the adjustment on the ex-day should equal the full size of the dividend in order for the market to be efficient. If the adjustment is either larger or smaller than the size of the dividend, the marginal investor should be able to make an arbitrage profit. In conclusion, our hypothesis based on differential taxes (or the absence of differential taxes for the marginal investor on the SSE) predicts that the price ratio on the SSE should be equal to one.

Hypothesis 1: The differential taxes hypothesis – the price ratio should equal one in the Swedish institutional setting.

To further determine the existence of tax-induced trading and its potential magnitude on the SSE we base our second hypothesis on the test of abnormal volume around the ex-day on the study by Lakonishok and Vermaelen (1986). If we can establish on a statistically significant level that there is abnormal trading around the ex-day, this would support our hypothesis that short term traders impact the ex-day pricing in a manner consistent with the differential taxes hypothesis. Hence our hypothesis is that short term traders impact the price ratio.

Hypothesis 2: The abnormal volume hypothesis - short term traders focused on the impact of the dividend should make the price ratio equal to one.

Previous studies such as Elton and Gruber (1970), Bali and Hite (1998) and Frank and Jagannathan (1998) have investigated the relationship between dividend yield and the price ratio. The larger the dividend yield the more important should the dividend be for investors. The findings in previous studies seem to indicate that higher dividend yield normally leads to more efficient ex-day share prices. Further, the larger the dividend yield the smaller the impact from tick sizes. As described above, price discreetness acts to limit the efficiency of the ex-day price adjustment. Our hypothesis is therefore that the price ratio should move towards one when the dividend yield increases on the SSE.

Hypothesis 3: The dividend yield hypothesis - the price ratio should move towards one when the dividend yield increases on the SSE.

3.2 PRICE DISCREETNESS HYPOTHESIS

Bali and Hite (1998) argued that due to the price discreetness of dividends and tick sizes the price ratios should be lower than implied by the differential taxes explanation. If a dividend is not an exact multiple of the tick size, it is impossible for the market to adjust the share price on the ex-day by the full amount of the dividend. Our third hypothesis is therefore that when the dividend is not an exact multiple of the tick size, we should find that the price ratio is significantly lower than when this adjustment problem is not present.

Hypothesis 4: The price discreetness hypothesis - the price ratio should be significantly lower for shares with dividends that are not exact multiples of the tick size.

3.3 BID-ASK BOUNCE HYPOTHESIS

As presented in the study by Bali and Hite (1998), the price ratios should be affected by the differential trading preferences between different investors. They suggested that one explanation why the price ratio is often found to be significantly lower than the prediction based on differential taxes, is that there exists a so-called bid-ask bounce from the cum-day to the ex-day. As sellers have a preference to sell their share on the cum-day and buyers to buy on the ex-day, the price adjustment on the ex-day tend to be biased downwards compared to the implications of the differential tax explanation. If we find that lower spreads make the price ratios more efficient, we should be able to confirm that there exists a bid-ask bounce effect on the SSE.

Hypothesis 5: The bid-ask bounce hypothesis - the price ratio should move towards one when the spread decreases on the SSE.

3.4 MOMENTUM HYPOTHESIS

The adjustment of a specific share price on the ex-day is affected by factors other than pure dividend-motivated trading. In our study we include two variables that capture the trend in the share price before the ex-day. If the ex-day of a company happens to fall during a period of positive or negative momentum the pricing of the company's share might be impacted by this momentum. If the trend is significant it might distort the ex-day price ratio.

Hypothesis 6: The momentum hypothesis – significant positive (negative) momentum should decrease (increase) the ex-day price ratio.

Table 3.1: Summary of hypotheses

Hypotheses:
H1: The differential taxes hypothesis – the price ratio should equal one in the Swedish institutional setting.
H2: The abnormal volume hypothesis - short term traders focused on the impact of the dividend should make the price ratio equal to one.
H3: The dividend yield hypothesis - the price ratio should move towards one when the dividend yield increases on the SSE.
H4: The price discreetness hypothesis - the price ratio should be significantly lower for shares with dividends that are not exact multiples of the tick size.
H5: The bid-ask bounce hypothesis - the price ratio should move towards one when the spread decreases on the SSE.
H6: The momentum hypothesis – significant positive (negative) momentum should decrease (increase) the ex-day price ratio.

4 METHOD AND DATA

The data for the price ratio is not readily available, nor are we aware of any previous studies on the SSE of the dividends for the fiscal years 2000 – 2004 (paid out during 2000-2005). Therefore we have created our own database, which include all available 632 dividends paid out during the period by a total of 152 companies. In addition we have created two more datasets of the share price development and the traded volume around the ex-dividend date in order to measure share price momentum and abnormal trading.

Table 4.1: Summary of explanatory variables

Variable name	**Definition**
Price ratio	Measures the relationship between the change in the share price between the cum-day and the ex-day, compared to the size of the dividend
Adjusted price ratio	Measures the relationship between the change in the share price, controlled for movement in the SSE market index (OMX_PI), between the cum- and the ex-day, compared to the size of the dividend
Dividend yield	Measures the importance of the dividend, by comparing the size of the dividend to the share price on the cum-day
Abnormal volume dummy	Indicates whether abnormal trading occurs on the cum- and ex-day – the dummy takes the value of 1 if there is abnormal trading and 0 otherwise
Momentum dummy	Indicates whether an abnormal positive (negative) trend prevails in the period leading up to the ex-day – the dummy takes the value of 1 if there is positive (negative) momentum and 0 otherwise
Tick size dummy	Indicates whether the dividend is an exact multiple of the tick size – the dummy takes the value of 0 if this is the case, otherwise the dummy takes the value of 1
Market return adjustment	Measures the change in the share price between the cum- and the ex-day. The variable is used to adjust the price ratio for the ex-day market movement in order to obtain a less distorted price ratio in the multivariate analysis
Spread	Measures the cost to trade by using the tick size as a proxy for the difference between the bid and ask price in relation to the size of the dividend

4.1 DATABASE DESCRIPTION

The database comprises several different variables; the price ratio, dividend yield, abnormal volume dummy, momentum dummies, tick size dummy, market return adjustment and the spread. In this section we outline a description of the different variables, and how they have been calculated and collected.

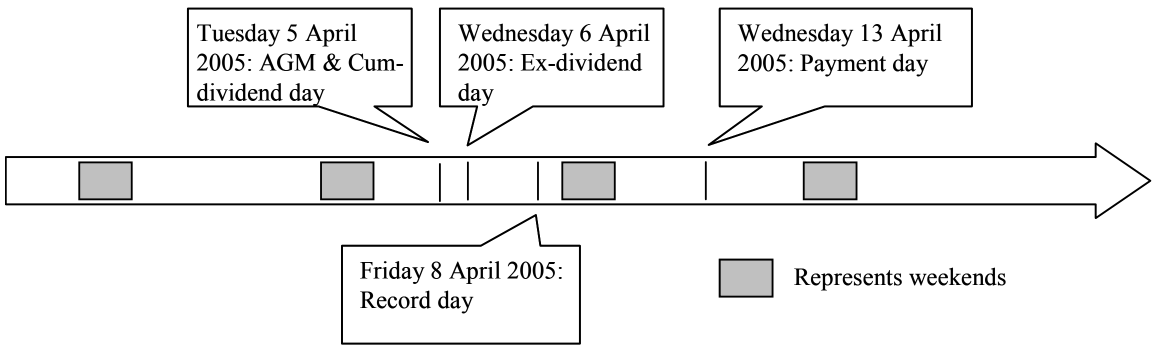
4.1.1 PRICE RATIO

The database include the current companies on the SSE and in our database we have been able to gather data on 632 dividends paid during the period, which corresponds to almost all dividend paid out during the period, adjusted for a few dividends for which we were unable to either obtain data on the record day or where there was no trading on the cum- or ex-day. For Swedish companies dividends are paid once a year after the full year accounts are presented, while for some foreign companies dividends are paid semi-annually or quarterly. For example Autoliv pays quarterly dividends and AstraZeneca pays semi-annual dividends.

To create the database we have gathered data on record days and dividend amounts primarily from press releases and annual accounts from the companies. In cases where the information was not available from these sources we have contacted the companies' investor relations departments. The relevant share price data for the 152 dividend paying companies has been downloaded from the official OMX homepage, along with the index data for OMX_PI, the all-share index of the SSE.

In order to calculate the price adjustments for dividends we have collected data on record days for dividends each year and subsequently calculated the corresponding cum- and ex-day. The record day is the last day an investor must be registered as a shareholder in a company to be eligible for the upcoming dividend. Due to the three day settlement practice on the SSE, this implies that the cum-day will be three trading days before the record day. The ex-day will hence be the following day, or two days before the record day. To control for weekends and public holidays between the record day, the ex-day and the cum-day, we have used the historic price data to verify the correct ex- and cum-day in cases where this has not been available directly. The price adjustment of the share between the closing price on the cum-day and the closing price on the ex-day corresponds to our calculated variable price ratio. Due to limited or non-existent pre-trading in many of the smaller company shares on the SSE we do not use opening prices on the ex-day. In order to create a measurement that is consistent and meaningful throughout the sample we hence use closing prices on both days. The dividend is not paid out during the cum-, ex- nor the record day, instead the payment date is often in the weeks following the record day. For some foreign companies the payment day can actually differ substantially from the record day, for example the 2004 first semi-annual dividend from AstraZeneca where the record day was 11 February and the subsequent payment day was 21 March. See below figure 4.1.1.1 for a timeline of a typical dividend payment:

Figure 4.1.1.1: Timeline of the SCA dividend period for FY2004 (paid out in 2005)



For the companies which pay dividends nominated in a foreign currency, for example Autoliv (US dollar), Nobel Biocare (Swiss francs) and TietoEnator (Euro), we have converted the dividend into Swedish currency using data on the foreign exchange spot rate prevailing on the ex-day from DataStream.

For non-cash dividends in the form of distributions of listed shares we have calculated the value per ordinary share as of the ex-day (see appendix A for an example of how these adjustments have been done). Typical examples are when Volvo distributed Ainax shares and when Fabege distributed shares in Klövern to their shareholders. However, in certain cases such as when Fabege distributed shares in the unlisted company Wilhborgs Syd we have not been able to infer any exact value on the ex-day as the price of each Wilhborg Syd share was not determined until after the ex-day. These kinds of distributions, where no exact value can be inferred on the ex-day, have hence been excluded from our database of dividends.

4.1.2 DIVIDEND YIELD

The dividend yield variable is not a primary variable, but rather calculated from other variables. We define the dividend yield as the dividend relative to the cum-day share price. We use this ratio as a proxy for how important the dividend is to investors. A higher value implies that the dividend represents a larger part of the value of the investment, and hence we anticipate more focus on the price ratio on the ex-day.

$$Dividend\ Yield = \frac{Div_t}{S_{t-1}}$$

4.1.3 ABNORMAL VOLUME DUMMY

According to the study by Lakonishok and Vermaelen (1986) there is evidence that short-term traders have an impact on how ex-day prices are set. In their study they found abnormal volume around ex-days. In our study we adjust and test if abnormal volume is an indicator of more efficient ex-day prices. Therefore we have included a variable that captures abnormal volume on the ex- and cum-day, calculated using an event study approach. According to our prediction there should be a difference between shares where there is significant abnormal trading on these two days and we have constructed the variable as a dummy which takes on the value of 1 if there is abnormal volume and 0 otherwise. We include tests of abnormal volume on both the 5% and 10% significance levels as a robustness check for our results.

More formally we use the standardized procedure as described in Lakonishok and Vermaelen (1986) regarding abnormal volume where:

$$SAV_t = \frac{AV_t}{\sigma(AV_t)}$$

SAV is the sample abnormal volume over the cum- and ex-day (or from t-1 to t=0), AV is the abnormal volume and the denominator determines the standard deviation of the abnormal volume as calculated in our sample period from t-10 to t-69 (60 day estimation window). To aggregate the SAV we use:

$$\hat{t} = \frac{\left(\sum_{t=1}^{T} SAV_t\right) \Big/ T}{\sigma(\overline{SAV})}$$

Where the average SAV is calculated as the square root of the inverse of the number of observations (2 observations in our sample).

4.1.4 MOMENTUM DUMMY

Similarly to the effect from abnormal volume we include two variables that captures momentum effects. The reason to include momentum effects is that if the share price has a trend, positive (negative), on the ex-day, then our price ratio statistics should be biased downwards (upwards). To control for this we include both a positive and a negative momentum dummy. The dummies take the value of 1 if there is a momentum (positive or negative) and 0 if there is no momentum. Furthermore, the momentum might be short or long term. Since we are interested in momentum on the ex-day we anticipate that short term momentum is more important but as a robustness check we have included momentum dummies for 5, 10, 30 and 60 days prior to the ex-day.

Since the two momentum dummies are designed to capture the impact from the share price momentum during the ex-day, we are interested in assigning the rank value 1 only to observations that should have a significant distortion on the ex-day by the momentum. We chose two cut-offs for the momentum dummy in order to check the robustness of the results: 5% and 7.5% abnormal return above (below) the market index for the positive (negative) momentum. The dummies are hence mutually exclusive. If for example the index gains 5% during the 5 days prior to the ex-day and the share gains 10% the abnormal return would be 5 percentage units. In this case the particular observation would be considered to have a five day momentum on the first (5%), but not on the second (7.5%) cut-off level.

4.1.5 TICK SIZE DUMMY

In previous studies such as Bali and Hite (1998) it has been argued that tick sizes will distort the price ratio if the dividend is not an exact multiple of the tick size. In order to test this statement we include tick sizes in our database. As seen in table C.10 in the appendix the tick size is related to the magnitude of the share price, but always discrete and hence makes it hard for investors to adjust correctly for the dividend on the ex-day. To capture the effect of tick sizes we have constructed a dummy which takes the value of 0 if the dividend is an exact multiple of the tick size and the value of 1 if it is not. The tick size dummy should capture the impact from price discreetness on the price ratio.

4.1.6 MARKET RETURN ADJUSTMENT

For our price ratio variable we are interested in capturing how the share price reacts to the fact that the dividend is not included in the value of the share on the ex-day. Hence, if the market gains during the day, it is reasonable to assume that many of the individual shares should increase as well. On average the beta values of the shares are close to one, since we include almost all shares traded during the period. As a simplification we therefore assume that each share has a beta of one, and adjust for market movements by subtracting the change in the all-share index (OMX_PI) from the return of the shares during the ex-day. This is similar to the approach in previous studies.

A different approach would be to estimate each individual beta to adjust for the ex-day market movements. While this could be theoretically interesting, we have chosen to not to estimate each individual beta, due to several reasons. First, we believe that such an approach would add little additional value as we on average will have a beta of one and hence our average price ratios should not change much. Second, as argued by among others Fama and French

(1992), the beta might not be able to fully explain the variation in expected return - especially not during one isolated trading day.

In our study we use two different market adjustments. In the multivariate regression approach we add an explanatory variable (‘market return adjustment’) to the regressions which measures the impact from market movements on the price ratio. In the univariate approach we instead adjust the price ratio for the distortions by the market movements directly. The price ratio adjusted for the movements in the SSE general index (OMX_PI), which is used in the univariate approach is shown below (‘Adj_PR’). This adjusted price ratio should control for the distortions of the price ratio caused by market movements on the ex-day.

$$Adj\_PR_t = S_{t-1} \times \frac{\left[\left(\frac{S_{t-1} - S_t}{S_{t-1}}\right) - \left(\frac{OMX\_PI_{t-1} - OMX\_PI_t}{OMX\_PI_{t-1}}\right)\right]}{DIV_t}$$

The market return adjustment variable will equal the difference between the price ratio and the adjusted price ratio (adjusted for market movements). Hence, if the price ratio is 0.55 and the adjusted price ratio is 0.65, the market return is equal to 0.10. This allows us to control for distortions caused by market movements in the regression. Any relationship we find for the different explanatory variables should be robust when we control for market movements, otherwise we are not able to make any inferences about why the price ratio differs from one on the SSE. The formula for the market return adjustment (‘Adj_MR’) is shown below.

$$Adj\_MR_t = -S_{t-1} \times \frac{\left[\frac{OMX\_PI_{t-1} - OMX\_PI_t}{OMX\_PI_{t-1}}\right]}{DIV_t}$$

4.1.7 SPREAD

The bid-ask bounce effect, as explained in the theoretical framework, might explain why the price ratio is different from one. When dividend-motivated investors choose to trade around the ex-day in order to avoid handling the dividend, they incur costs. Dividend-motivated buyers and sellers primarily trade with an arbitrageur on the cum- and ex-day. Since these dividend-motivated traders have a clear preference when to trade, most sellers will have to accept the bid price on the cum-day and most buyers have to accept the ask price on the ex-day. Therefore the spread between the bid and ask price becomes a trading cost which will lower the efficiency of the dividend adjustment and make the price ratio on average less than one. Since the empirical spread cannot be practically summarised we choose the tick size as a reasonable proxy. The implication is that the bid price, on average, is one tick below the ask price. We primarily use this proxy to investigate the implications of the bid-ask bounce effect on the SSE price ratio. The spread should also be correlated with trading costs in general. Since the effective transaction costs are hard to control for, our spread variable might detect effects from both the bid-ask bounce and from transaction costs. Hence, our tests using the spread variable also implicitly investigate the effects from transaction costs. The spread variable is defined to allow us to measure the relative importance of the tick size to the size of the dividend, or formally:

$$Spread_t = \frac{Tick\ size_t}{Div_t}$$

4.2 DESCRIPTIVE STATISTICS

In the analysis we use the different variables described above to test our hypotheses regarding the behaviour of the price ratio. Hence our main statistic is the price ratio, which describes how much the share price adjusts on the ex-day compared to the dividend. A value of one would indicate that the decline in the share price is equal to the size of the dividend, while a value of more than one would indicate that the share price decline is larger than the dividend. Similarly a value of less than one signifies that the decline is less than the full amount of the dividend. Finally a value of less than zero (negative price ratio) indicates that the share price has increased on the ex-day. Such an increase in the share price can have several explanations, which we try to explain by using market adjustments and momentum effects.

4.2.1 PRICE RATIO

The average price ratio in our full sample is 0.72 (median 0.80) with a standard deviation of 1.72, indicating that there are negative outliers which impact the average price ratio downwards compared with the median estimate. The implication of this is that investors on the SSE value 1 SEK in dividend to 0.72 SEK in capital gain. The median better compares to the tax based hypothesis of an average price ratio of one. We have a significant dispersion of observations, ranging from a maximum value of 14.17 for Skandia in 2000 to a minimum value of -7.91 for AstraZeneca in 2000, indicating that other things than purely the dividend capturing trading was taking place during these days. Therefore we will adjust for market movements in our sample and control for momentum effects in our effort to better understand the price ratio.

4.2.2 DIVIDEND YIELD

The average dividend yield in our full sample is 3.5% (median 3.1%) with a standard deviation of 2.85%. There is a large dispersion also in the dividend yield as the smallest are close to zero and the largest is 35% for Bure in 2000 when they both had a cash dividend of 3 SEK at the same time as they distributed shares in Observer to their shareholders worth c. 14 SEK per share in Bure. The total dividend of c.17 SEK was 35% of the cum-day price of 49.40 SEK. It is important to note that this dividend yield is calculated using only the companies that pay dividends, hence the average dividend yield on the SSE for the sample period is lower if all companies are considered.

4.2.3 DUMMY VARIABLES

The dummy variables in our database include the tick size dummy, abnormal volume dummy and dummies for positive and negative momentum (see table 4.2.1 below). The dividends are often exact multiples of the tick sizes on the SSE, only 30% of our observations are potentially impacted by price discreetness and receive the value 1 for the tick size dummy. For the volume dummy we use two significance levels (5% and 10%) in order to check the sensitivity of the variable. For the 5% level we find that 114 observations have abnormal trading (or 18% of our sample), and for the 10% level we find that 137 observations have abnormal trading (or 22% of our sample). The two momentum dummies we use (positive and negative) are mutually exclusive and hence for any given observation there can only be a positive or negative momentum, never both. For the 5 day momentum we find that 110 observations have positive momentum (17% of the sample) while 48 observations had negative momentum (8% of the sample). Here we have used 5% positive or negative abnormal return as a cut-off level to qualify as momentum. In table C.11 in the appendix we have a complete summary table for our variables, which also include the other significance levels for the volume dummy and the 10, 30 and 60 days positive and negative momentum dummies.

Table 4.2.1: Summary table of selected dummy variables

	Tick size dummy	**Abnormal volume dummy (5% level)**	**Positive momentum over 5 days**	**Negative momentum over 5 days**
Number of significant observations	187	114	110	48
Portion of sample	30%	18%	17%	8%

4.2.4 SPREAD

The average spread in our sample is 0.15 (median 0.10) with a standard deviation of 0.137. As before, there is a large dispersion in the spread as the smallest are close to zero and the largest is 1.11 (or 111% of the dividend) for Observer in 2000 when they paid a dividend of 0.45 SEK where the share price was 103 SEK on the cum-day. Hence, observations where the spread variable tends to be large the dividend yields tend to be small (0.4% for Observer in 2000). We suspect that the dividend capturing trading is relatively small when the trading costs and the spread are high in relation to the dividend. If the investor has to pay more in spread trading costs than he or she actually receives in dividend, the trades should not be made.

4.2.5 TRIMMING THE SAMPLE

In our sample there are a few significant outliers which cannot be rationally explained by differential taxes or the market microstructure explanations. We therefore, to minimize the impact from large positive and negative observations on our results, trim the sample. The top 2.5% and bottom 2.5% observations of both the full sample and the market adjusted sample were trimmed (see the 32 excluded observations in table C.1), in accordance with previous research (Graham et al (2003)). The subsequent samples are hence less dispersed and should contain the observations which are most relevant for our study. The descriptive statistics for the four samples are presented in table 4.2.2 below.

Looking at the excluded observations it is obvious that low dividend yield, as expected, weakens the implications from the explanations above. All observations, except two, have yields below 2.5%. The majority of the outliers represent payments made in the beginning of our sample period during the bear market years of 2001 and 2002. Notable is that there is also a clear majority of smaller companies among the extreme observations, and also Autoliv and AstraZeneca, which pays quarterly and semi-annual dividends. The explanation for this might be that firm specific factors which cause large swings in share prices are more important for smaller companies. Larger companies tend to have lower volatility and are presumably more accurately priced, which causes less extreme observations in the price ratio variable.

Table 4.2.2: Data on the price ratio statistic

Sample	No. of obs.	Average	Median	St. dev.	Std. error of the mean	Max	Min
Original	632	0.72	0.80	1.72	0.07	14.17	-7.91
Trimmed original	600	0.71	0.80	1.11	0.05	4.25	-3.16
Market adjusted	632	0.70	0.78	1.93	0.08	24.00	-9.61
Trimmed market adjusted	600	0.70	0.78	1.09	0.04	4.07	-3.62

5 EMPIRICAL FINDINGS – UNIVARIATE ANALYSIS

In our univariate analysis, we investigate the relationship between the price ratios and the explanatory variables on a stand-alone basis. We test our hypotheses with methods and statistics based on the principles used in Newbold et al (2003) and Gujarati (2003). In the subsequent section we compare our results with a multivariate analysis of our data, where we add an additional dimension to the analysis by including interaction effects between the explanatory variables.

5.1 EMPIRICAL DATA ON THE STOCKHOLM STOCK EXCHANGE 2000-2005

To illustrate our findings we have plotted the distribution of the price ratios of our four samples in figure B.1 in the appendix, where the observations are divided into subintervals of 0.25. The distribution for the full sample does not closely follow the normal distribution as it has more kurtosis and more outliers than a normal distribution. However, when we trim and market adjust the sample we obtain a distribution which more resembles the normal distribution, which justifies our adjustments to the data. The average price ratio for the untrimmed market unadjusted sample is 0.72 and the median 0.80, with a clear clustering around one as seen in figure B.1.

5.1.1 DIFFERENTIAL TAXES EFFECTS

Our first hypothesis concerns how the differential taxes affect the price ratio on the SSE. According to the differential taxes hypothesis we believe that the implied price ratio in our study is one. Consequently, we test if the point estimate of 0.72 in our sample is significantly different from one. We also test if the average price ratio of our three other samples are significantly different from one. As can be seen in table 4.2.2 the average price ratios are similar in the four samples, while the standard error decreases when we trim and market adjust the samples.

The test for if the ex-day average price ratio is equal to one is constructed in the following way: the null hypothesis is that the average price ratios is equal to one and the alternative hypothesis is that the average price ratio is different from one (see table C.2 in the appendix for the formal test setup). In contrast to our hypothesis we are able to conclude that the average price ratios in the four samples are all significantly different from one on the 5% significance level. The only possibility for the differential taxes hypothesis to hold on the SSE would be if foreign investors have a different tax setup than we have identified where their implied price ratio according to equation 2 is 0.72. We continue with further tests to understand how the behaviour of the ex-day price ratio on the SSE compares to findings in previous studies.

Our abnormal volume hypothesis concerns to what extent short term traders impact the price ratio. The reason why it is interesting to investigate this hypothesis is that short term traders normally act to make share prices efficient. Without them the share prices would be less informative and noise traders should have a greater impact. In our study we build upon the study by Lakonishok and Vermaelen (1986) to determine if the price ratio is impacted by these short term traders. First, we test to see if there is significant abnormal volume on the SSE during the cum- and ex-days, second we test if abnormal volume is more prominent among companies with high dividend yield and finally we test if the price ratios are different for the observations with and without abnormal volume.

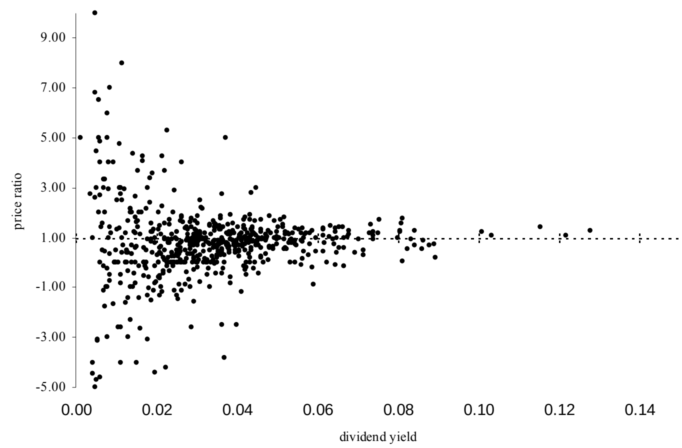
In table C.3 in the appendix we describe the formal test of abnormal volume on the SSE during the cum- and ex-days. The null hypothesis is that there is no abnormal volume and the alternative hypothesis is that there is abnormal volume. We test this effect for each observation separately, compared to Lakonishok and Vermaelen (1986) who test at an aggregate level. As seen in the appendix, we find that there are 114 observations (18% of the sample) with abnormal volume at the 5% significance level and 136 observations (22% of the sample) at the 10% significance level. We can hence infer that short term traders are active around the ex-day. These abnormal volumes can also be a sign of firm-specific trading around the AGM. However, our interpretation of the findings is strengthened by the fact that a large portion of the abnormal trading observations come from large companies on the A-listan on the SSE, which are less volatile and presumably priced more efficiently than the smaller companies.

In the second test, where we test if the dividend yield is higher for the observations with abnormal volume (using the 5% significance level), we first divide the original sample in two groups, one containing all observations with abnormal volume at the 5% level and the other containing the residual observations. The average dividend yield in the first group is 4.25% with a standard deviation of 3.33% and the average dividend yield in the second group is 2.93% with a standard deviation of 1.63% (See table C.3 in the appendix for a description of the sample using the 10% significance level). The null hypothesis in our test is that the dividend yields are equal in the two samples and the alternative hypothesis is that the dividend yields in the two samples are different. Under the formal test we are able to reject the null hypothesis that the dividend yields are higher in the group with abnormal volume. Hence, we can conclude that abnormal trading mostly occurs for shares with higher dividend yield, which is consistent with our prediction that dividend capturing behaviour should be more significant when dividends are relatively more important to investors.

Now when we have concluded that there exist short term trading around the ex-day, we want to investigate if the price ratio for the observations with abnormal volume more closely conforms to the differential taxes hypothesis. If so, the dividend capturing trading should drive the price ratio towards one. The sample is now split into one group with price ratios for shares with abnormal trading (using the 10% significance level) on the ex-day and one group of price ratios for shares without abnormal trading. The null hypothesis in our test is that the price ratios in the two samples are equal and the alternative hypothesis is that the price ratios in the group with abnormal volume are higher. We perform the test both on the original sample and the trimmed market adjusted sample. Our hypothesis fails for the original sample as the average price ratio is lower for the group with abnormal volume than the group without abnormal volume (average price ratio of 0.58 versus 0.74 in the two groups, see table C.4 in the appendix). However, when we control for market movements and outliers we obtain different results as the average price ratio in the group with abnormal volume is 0.80 compared to 0.67 in the group without abnormal volume. However, we are not able to reject the null hypothesis that the observations with abnormal volume have higher price ratios at either the 2.5% or the 5% significance level. Our conclusion is that it is not possible for us to detect the impact from short term traders in the original sample due partly to the distortions from the market movements and significant outliers. Our results more conform to our hypothesis when these adjustments are made, but we are still not able to validate the results with statistical significance.

Finally, we test our dividend yield hypothesis that the price ratio should move towards one when the dividend yield increases on the SSE. We test this by splitting the sample into quartiles (see table C.5 in the appendix). The lowest dividend yields are sorted into the first quartile and the highest into the fourth quartile. Our null hypothesis is that the price ratios in the first and fourth quartiles are equal and the alternative hypothesis is that the price ratios are higher in the fourth quartile (see table C.6 in the appendix for the results and a formal description of the test). As before, we test both for the original sample and for the trimmed market adjusted sample. We are unable to reject the null hypothesis for both tests. The results are significantly more in line with our expectations for the trimmed market adjusted sample, but we are still not able to reject the null hypothesis. This means that we cannot conclude that higher dividend yield actually makes ex-dividend price adjustments more efficient on the SSE. We continue by plotting the price ratio against the dividend yield in order to get a better understanding of the relationship between the variables (see figure 5.1.1.1 below).

Figure 5.1.1.1: The price ratio plotted versus the dividend yield – the price ratio is on the vertical axis and the dividend yield is on the horizontal axis



As can be seen in the figure, the relationship between the dividend yield and the price ratio is strong. For low dividend yield observations the resulting price ratios vary significantly, but the higher the dividend yield, the lower the dispersion is around our predicted value of one for the price ratio. The relationship seems to be non-linear as the price ratio asymptotically converges to one for higher dividend yield observations. We further investigate the relationship in the multivariate analysis.

Table 5.1.1 Summary of empirical findings - part 1

Hypotheses	Test-result	Findings
Differential taxes		
H1: The price ratio should equal one in the Swedish institutional setting	*Rejected*	We conclude that the price ratio is significantly lower than one for our four samples
H2: Short term traders focused on the impact of the dividend should make the price ratio equal to one	*Data supportive but fails to statistically validate*	We conclude that there is ex-day trading on the SSE by short term traders, especially for higher dividend yield shares, however we are not able to conclude that they have an impact on the price ratio
H3: The price ratio should move towards one when the dividend yield increases on the SSE	*Data supportive but fails to statistically validate*	We find that the price ratio increases with higher dividend yields, but fail to validate the results on a statistically significant level

5.1.2 PRICE DISCREETNESS EFFECTS

Our price discreetness hypothesis is that tick sizes have an impact on the price ratio when the share price is unable to adjust correctly for the value of the dividend on the ex-day due to price discreetness. In our sample we have 187 observations where the dividend is not an exact multiple of the tick size, which represents 30% of the sample. As explained above we argue, in accordance with previous research, that the ex-day adjustment in this case should be biased downwards. The reason is that investors should round the price adjustment downwards (lower decline in the share price than the full amount of dividend), as no one should be willing to adjust the share price downwards by more than the full amount of the dividend on the ex-day.

We test the price discreetness hypothesis by splitting our data in two different groups; one that includes the observations where the dividend is not an exact multiple of the tick size and one that includes the remaining observations. Our null hypothesis is that the price ratios are equal in the two groups and the alternative hypothesis is that the price ratio is lower in the first group (see table C.7 in the appendix for the formal test statistics). We are not able to reject the null hypothesis that the price ratios are equal for either the original sample or the trimmed market adjusted sample. However, the average price ratios do move in the right direction, as the average price ratios are lower for the groups which should be affected by price discreetness compared to the groups that are not. A more detailed multivariate analysis should be able to capture the relationship.

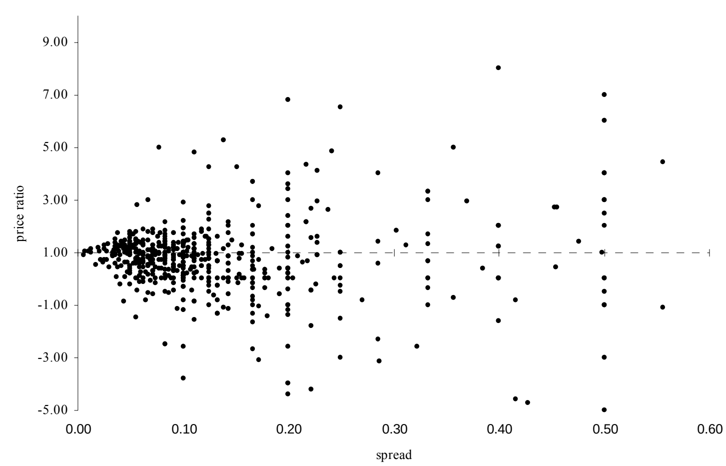
5.1.3 BID-ASK BOUNCE EFFECTS

The results from the testing of the differential taxes hypothesis confirms that the average price ratio is significantly lower than one on the SSE. We interpret this as that the differential taxes hypothesis cannot fully explain the ex-day price behaviour on the SSE. As Frank and Jagannathan's (1998) study indicated, a formal study of the bid-ask bounce effect is hard to design and the feasible tests are limited due to data availability. We restrict our testing of the bid-ask bounce effects to investigate the relationship between the spread and the price ratio. Our prediction is that higher spreads have a twofold impact, first it should increase the bid-ask bounce as the difference between trades on the ask and the bid price increase and it should also imply higher transaction costs for dividend motivated traders. The effects have a different impact on the price ratio. The bid-ask bounce is strictly negative, while higher transaction cost should lower the incentive to trade which would lead to a less efficient price ratio.

We use two samples to test the bid-ask bounce hypothesis, the original sample and the trimmed adjusted sample. Both samples are divided into four groups (quartiles) based on the spread variable. The first quartile contains the observations with the highest spreads and the fourth the observations with the lowest spreads. We test if the average price ratios in the extreme groups are equal or not. The formal hypothesis and the descriptive statistics can be found in table C.8 in the appendix. In the test we are not able to conclude that there is a significant difference in the average price ratios for neither of the two samples between the first and fourth quartiles. However, there seem to be a trend that lower spreads increase the average price ratio towards one, in both samples the average price ratios in the first quartile deviate from this pattern.

There seems to be a clustering of price ratios around one for low spread observations (see figure 5.1.3.1 below). The relationship displayed appears to illustrate a pattern inconsistent with the pure bid-ask bounce effect. This can be an indication of distortion caused by the correlation of the spread variable with transaction costs. It seems that higher spreads induce randomness. Perhaps the impacts from transaction costs on the price ratio dominate the bid-ask bounce effect for high spreads. We investigate this further in the multivariate analysis.

Figure 5.1.3.1: The price ratio plotted versus the spread – the price ratio is on the vertical axis and the spread is on the horizontal axis



5.1.4 MOMENTUM EFFECTS

Our sixth and final hypothesis concerns the momentum effect. This relationship has to the best of our knowledge not been investigated in this context before, but could potentially have a significant impact on the price ratio. The potential effect from a momentum in the share price is to distort the 'true' price ratio. In our prediction a short-run momentum should be more important in understanding the ex-dividend price behaviour since the likelihood that the momentum should be sustained during the ex-day is larger under a shorter isolated period. We have defined momentum during a specific time period as a significant abnormal return above or below the market index during that time. Our cut-off levels for momentum is based on what levels would be sufficient on a daily basis to significantly distort the price ratio. For example a 5 percentage units abnormal return (return above OMX_PI) over a five day period would result in a 0.98% daily return, compared to the average dividend yield found in our study of 3.5%. This would imply that the price ratio could be distorted by (0.98/3.5=) 0.28, which would represent a significant part of our average price ratio of 0.72.

In order to check the robustness of our results, we include two cut-off levels for the 5 day share price momentum, which is the period we believe should have the largest impact on the ex-day share price behaviour. The two cut-off levels are 5 percentage units and 7.5 percentage units positive or negative abnormal return over the 5 day period. In table C.11 in the appendix we report the descriptives of all the dummies, however, we continue to focus on the short term momentum. Table 5.1.3.1 below displays the breakdown of the number of significant observations for 5 day positive and negative momentum on both the 5 and 7.5 percentage units level on the different lists on the SSE, in our original sample:

Table 5.1.3.1: Significant observations for 5 day momentum (5 / 7.5 percentage unit cut-off level) – original sample

Dummy	A-listan	A-listan övriga	Attract 40	O-listan
Positive	21 / 8	19 / 7	22 / 12	59 / 33
Negative	6 / 2	9 / 2	9 / 7	25 / 14

We test our hypothesis that share price momentum should have an impact on the ex-day share price behaviour in two steps. In order to perform meaningful tests we divide the sample in three groups, one with the positive momentum observations, one with the negative momentum observations and one containing the residual observations without momentum (the neutral group). The test thereafter is done to see if the price ratios in the two momentum groups are significantly different from the neutral group. First we use the positive momentum observations, for which we expect a lower price ratio on the ex-day due to upwards pressure from the share price momentum. See table C.9 in the appendix for the formal test and test results, where our null hypothesis is that the price ratios are equal in the two groups (the group with positive momentum and the group without momentum), and the alternative hypothesis is that the price ratio is lower in the group with positive momentum. Interestingly, our results are strongest in the unadjusted sample, where we can reject the null hypothesis that the two groups have equal price ratios at the 5% significance level. Hence we can conclude that the observations with positive 5 day share price momentum for both 5 and 7.5 percentage units' abnormal return are significantly lower than for the neutral control group. Our own hypothesis seems to help explain why the price ratio on average differs from the prediction by the differential taxes hypothesis.

The test for negative momentum is similar to the test for positive momentum, with the difference that we expect higher price ratios for the negative momentum observations due to the added downwards pressure from the negative share price momentum during the ex-day. See table C.9 in the appendix for the formal test and test results, where our null hypothesis is that the price ratios are equal in the two groups (the group with the negative momentum and the group without momentum), and the alternative hypothesis is that the price ratio is higher in the group with negative momentum. The results from the test of negative share price momentum do not conform as well to our predictions. In fact, only one of the four individual tests moves in the right direction and is not significant (the 5 day negative share price momentum using 5 percentage units abnormal return). Hence, we can not conclude that the negative share price momentum explains a significant part of the ex-day share price behaviour on the SSE during our period of interest.

Table 5.1.2: Summary of empirical findings - part 2

Hypotheses	Test-result	Findings
Price discreetness hypothesis		
H4: The price ratio should be significantly lower for shares with dividends that are not exact multiples of the tick size	*Data supportive but fails to statistically validate*	We find that for observations with dividends which are not an exact multiple of the tick size, the price ratio is on average lower than otherwise, but we fail to validate the results on a statistically significant level
Bid-ask bounce hypothesis		
H5: The price ratio should move towards one when the spread decreases on the SSE	*Data supportive but fails to statistically validate*	We find that the price ratio increases with lower spreads, but fail to validate the results on a statistically significant level
Momentum hypothesis		
H6: Significant positive (negative) momentum should decrease (increase) the ex-day price ratio	*Inconclusive*	We conclude that 5 day positive momentum has a significant impact on the price ratio, while the 5 day negative momentum does not follow our prediction

5.2 SUMMARY OF THE EMPIRICAL FINDINGS

The univariate analysis has improved our understanding of the ex-day share price behaviour on the SSE. We now know that the price ratio on average is strictly less than one, which means that the differential taxes explanation is not exhaustive. Thereby we by no means imply that investors do not take taxes into consideration when they value the dividend. However, there are certain factors which cause the price ratio to deviate from the predicted value. The data is mostly supportive of our hypotheses, except for the differential taxes hypothesis, but due to the crude nature of the univariate analysis and the influence of extreme observations we are not able to statistically validate any of the other hypotheses. Unfortunately, we are not able to confirm that share price momentum is able to explain the variation in the price ratio.

The implication of our findings thus far is that differential taxes are not the sole driver of the price ratio. Economically the interpretation is that 28% of the dividend value on the SSE is left on the table (the price ratio is on average 0.72). An investor who buys the share on the cum-day and sells it on the ex-day would make a profit of 28% of the dividend value on average during our sample period. Our aim is to refine the univariate analysis in order to determine whether this profit persists when price discreetness, bid-ask bounce and share price momentum are considered jointly. We therefore continue by employing a multivariate analysis, in which we are able to simultaneously control for our different explanatory variables as well as include our whole sample in each test. This increases the likelihood of finding significant relationships between our explanatory variables and the price ratio and helps us to control for the non-linear relationships we found indications of in the graphical analysis above. If the profit persists it could be evidence of inefficiencies in the market.

6 EMPIRICAL FINDINGS – MULTIVARIATE ANALYSIS

Our focus with the multivariate analysis is to build upon and refine our univariate analysis. We investigate the data set using a panel data regression approach, in order to simultaneously control for all our explanatory variables. As indicated in the univariate analysis some of our variables might have a non-linear relationship with the price ratio. Using a regression approach we are able to take this into account and better estimate the impact on the price ratio. We begin by a brief discussion about our regression approach and more specifically how we control for the potential non-linearity.

6.1 HANDLING OUR PANEL DATA SET

Our data set comprises of observations on the price ratio for 152 different companies over five years, which means that we are dealing with a panel data set. We use the STATA programme to estimate our regressions as it has been reported to handle unbalanced panel data sets well (Yaffee (2003)). Due to missing data and certain companies which have not paid dividends throughout the period, we face an unbalanced panel, which is automatically accounted for in the STATA programme as it adjusts the counts by eliminating the incomplete observations.

The choice of panel data regression to run depends on what we believe about the within and between variations in the sample (Princeton University – DDS (2006)). A fixed effects regression is used if we need to control for omitted variables that differ between our companies but are constant throughout the time period. This means that the effects of our explanatory variables on the price ratio are estimated using their changes over time. A between effects regression is used if we need to control for omitted variables that differ over time but are constant for our companies. This means that the effects of our explanatory variables on the price ratio are estimated using the changes between the companies. As a final model to use we can estimate a random effects regression which is a weighted average of the two other regressions as it allows both for between and within effects. Normally, a random effects model is preferable since it is a more efficient estimator but might not always be possible to use. In order to decide if we can run a random effects regression, we use the Hausman specification test.

6.2 MODIFYING THE VARIABLES

We make a few adjustments to our variables in order to control for the non-linear effects we detected in the univariate analysis. First, the relationship between the dividend yield variable and the price ratio seems to be asymptotic – for low dividend yield observations where the price ratio is below (above) one, the price ratio increases (decreases) towards one with higher dividend yields. Hence, we assume to find a positive relationship between dividend yield and the price ratio for observations with price ratios below one and a negative relationship for observations with price ratios above one. In order to capture this difference we include a dummy variable that takes the value of 1 for observations where the dividend yield is above one and 0 otherwise. This dummy variable is multiplied with the dividend yield variable, creating a new variable called 'd.divyield'. In the regression we include the two new variables to capture both the difference in levels for the two groups of dividend yield observations and the difference in slopes. Second, we expect to find a similar non-linear relationship between the spread variable and the price ratio. For observations with a price ratio below (above) one, we expect to find a negative (positive) relationship with the price ratio as increasing spreads imply larger distortions from one. The dummy variable handling resembles the dummy we include for dividend yield – the dummy takes the value of 1 if the price ratio is above one and 0 otherwise. The dummy is then multiplied with the spread variable to create a new variable called 'd.spread'. In the regression we include the two new variables to capture both the difference in levels for the two groups of spread observations and the difference in slopes. See the equations below for an exemplification of how to interpret the dummy coefficients in a regression setting, where Y represents the dependent variable, D the dummy variable and X the dividend yield variable (or the spread variable):

$$Y = \beta_0 + \alpha_0 D + ... + \beta_5 X + \alpha_5 DX + ...$$

when D = 0 then $Y = \beta_0 + ... + \beta_5 X + ...$

when D = 1 then $Y = (\beta_0 + \alpha_0) + ... + (\beta_5 + \alpha_5) X + ...$

The interpretation of the method we use is that both the intercept and the slope are allowed to differ for the two dummy groups. To exemplify, if α_0 and α_5 are significant for the dividend yield variable, then this would imply that the observations with price ratios above one have a different intercept and a different slope coefficient, compared to observations with price ratios below one.

The market adjustment is done somewhat differently in the regression analysis than in the univariate analysis. As mentioned in section 4, we now add a market return variable instead of running different regressions for the four different samples, which instead gives us two samples - the original and the trimmed sample. Other adjustments to our sample include eliminating dividend observations for Autoliv, AstraZeneca and TietoEnator where there is more than one observation per year, in order to estimate a consistent regression. Our original sample is now reduced to 610 observations, and the trimmed sample contains 580 observations, as we trim the 2.5% highest and lowest price ratios.

6.3 SPECIFYING THE MODEL

When we specify the model we need to take into account the patterns we found for the different variables in the univariate analysis. The main modifications include the new variables for dividend yield and spread we have detailed above, and in addition we are able to include a control variable for the market return ('Market return adjustment') in the regression (see table 6.3.1 below for a summary of the new variables included). The two dummy variables for dividend yield and spread (dummy div.yield and dummy spread) are perfectly collinear and we expect one of them to be dropped by STATA when we run the regression. However, if we would run the regression only using either the dividend yield variables or spread variables, the dummies would be used by STATA.

Table 6.3.1: List of new variables included and their expected sign where available

New variable included	Expected sign	Explanation
Dummy div.yield		Measures the difference in intercept between the dividend yield observations with price ratios above one compared to below one
d.div.yield	-	Measures the difference in slope between the observations for the dividend yield variable with price ratios above one and below one
Dummy spread		Measures the difference in intercept between the spread observations with price ratios above one compared to below one
d.spread	+	Measures the difference in slope between the observations for the spread variable with price ratios above one and below one
Market return adjustment		Measures the change in the share price between the cum-day and the ex-day. The variable is used to adjust the price ratio for the ex-day market movement in order to obtain a less distorted price ratio

Our other variables are included in the regression without adjustments, since we believe the relationship between these variables and the price ratio should be strictly linear - the tick size dummy, the volume dummy and the positive and negative momentum dummies. In table 6.3.2 below we summarize the expectations for the signs of the coefficients.

Table 6.3.2: List of other variables included and their expected sign

Variable included	Expected sign	Variable included	Expected sign
Tick size dummy	-	*Positive momentum dummy*	-
Volume dummy	+	*Negative momentum dummy*	+

We have detailed the variables we intend to include in the regression, and we have determined that a panel data regression is appropriate. The remaining uncertainty is which type of panel data regression to use - a fixed effects or random effects regression. In order to decide which model suits our data better, we perform the Hausman specification test. According to Yaffee (2003), the Hausman specification test is designed to detect 'whether there is significant correlation between the unobserved person-specific random effects and the regressors'. If such correlation exists the random effects model would be inconsistent and a fixed effects model would be preferred.

We run both a fixed and random effects regression in STATA to perform the Hausman specification test for both the original and the trimmed samples. The null hypothesis is that there is no correlation as described above and the alternative hypothesis is that there is correlation between the unobserved person-specific random effects and the regressors. The test results are summarized in table 6.3.3 below (see table D.1 in the appendix for the complete print out from STATA). If the p-value is higher than 0.05 (representing a 5% significance level) then we can use the random effects model, while if the reported χ^2 values are significant we should use the fixed effects model. As can be seen in the table we are safe to use the random effects model for both the original and the trimmed samples, as we are not able to reject the null hypothesis.

Table 6.3.3: Summary of Hausman specification test

Sample	Reported χ^2	p-value
Original	4.28	0.9339
Trimmed	6.25	0.7941

The corresponding model we use to test our hypotheses is detailed below. Note that the 'dummy spread' variable has been excluded since it is dropped in STATA due to perfect collinearity with the 'dummy div.yield' variable. The interpretation of the different dividend yield and spread coefficients is explained in section 6.2 above.

$$PR_{it} = \beta_0 + \beta_1 dividend\ yield_{it} + \beta_2 tick\ size\ dummy_{ti} + \beta_3 volume\ dummy_{it} + \\ \beta_4 positive\ momentum\ dummy_{it} + \beta_5 negative\ momentum\ dummy_{it} + \alpha_0 dummy\ div.yield_{it} + \\ \alpha_1 d.div.yield_{ti} + \beta_6 market\ return\ adjustment_{it} + \beta_7 spread_{it} + \alpha_2 d.spread_{it} + \varepsilon_{it}$$

6.4 REGRESSION RESULTS

The panel data is analysed using the random effects regression model. We run the regression on both our original and trimmed sample. They yield similar results; however the results are stronger, as expected, in the trimmed sample. In our study we are not interested in the pure noise observations, and therefore we focus our analysis on the trimmed sample. See table 6.4.1 below for a summary of the findings in the trimmed sample and see table D.2 in the appendix for the complete results for both samples.

Table 6.4.1: Summary of regression results for the trimmed sample

Variable	Coefficient	Expected sign	Confirms our expectation?
Dividend yield	3.81**	+	Yes
Tick size dummy	-0.12*	-	Yes
Volume dummy	-0.01	+	No
Positive momentum dummy	-0.04	-	No
Negative momentum dummy	0.02	+	No
Dummy div.yield	1.01**		No prediction
d.div.yield	-7.21**	-	Yes
Market return adjustment	-0.12**		No prediction
Spread	-2.76**	-	Yes
d.spread	5.62**	+	Yes

** Significant at 5% level, * significant at 10% level.

The results from the regression are broadly in line with our expectations. The dividend yield variables are highly significant with similar magnitude of the coefficients for both the observations with price ratios above and below one. The slope coefficient for the observations with price ratios below one is 3.81 and the slope coefficient for the observations with price ratios above one is -3.40 (=3.81-7.21). The implication of this is that as the dividend yield increases there is a sharp convergence of the price ratios towards one. The intercept is different between the observations with price ratios above and below one, however, our interest is primarily the relationship as measured by the slope coefficients. This confirms our third hypothesis that the price ratios on the SSE should move towards one when the dividend yields increases.

The price discreetness test is also supportive of our hypothesis as the tick size dummy is significantly negative, however, only on the 10% significance level in the trimmed sample. The coefficient is -0.12 which indicates that when the dividend is not an exact multiple of the tick size, i.e. when price discreetness is an issue, the price ratio on average decreases by 0.12.

The volume and momentum dummies are not found to significantly explain the variations in the price ratios. Their coefficients are all close zero with p-values above 0.75. These unexpected results can be caused by the limitations of dummy variables. It is possible that the low variation in the explanatory variables (only one and zero) coupled with few significant observations, cause the lack of significant results. Unfortunately, our new momentum variable was not found to explain the variations in the price ratio on the SSE. Consequently, we therefore reject the momentum and volume hypotheses.

The market movements are found to explain parts of the variation in the price ratio. We do not have any prediction for how the market movements should co-vary with the price ratio, rather the variable is included to control for the general movements on the SSE. Since the variable is found to be highly significant, we can conclude that our method to use an average beta of one for all observations works well as a proxy for more general price fluctuations on the SSE.

The spread variables are significant and confirm our prediction based on the univariate analysis that higher spreads should distort the price ratios. The slope coefficient for observations with price ratios below one is -2.76 and the slope coefficient for observations with price ratios above one is 3.02 (=-2.76+5.62). However, it is hard to disentangle the effects of transaction costs from the bid-ask bounce effects. If the coefficient for observations below one had been larger in absolute terms than the coefficient for observations above one, this could have been an indication of a bid-ask bounce effect. We conclude that tick sizes matter as a cost for dividend-motivated trading and should impact the price ratio.

6.5 COMPARING THE UNIVARIATE AND MULTIVARIATE ANALYSIS

In the univariate analysis we investigate the relationship between the explanatory variables and the price ratio separately, while we in the multivariate analysis are able to simultaneously control for all our theoretically motivated explanatory variables. Even though the univariate analysis is a crude method, it improves our understanding of how the price ratio co-varies with the explanatory variables. This is necessary for building our regression. Most of our findings in the univariate analysis are not significant but supportive of our expectations, except for the momentum hypothesis that is found to be inconclusive. The regression analysis is able to verify all of these indications, except for our abnormal trading hypothesis, on a statistically significant level. The momentum hypothesis is not found to have explanatory power in the regression either. For a summary of the tests of our hypotheses see table 6.5.1 below.

Table 6.5.1: Comparison of the univariate and multivariate analyses

Hypothesis	Results from univariate analysis	Results from multivariate analysis
H1: The differential taxes hypothesis – the price ratio should equal one in the Swedish institutional setting.	Rejected	-
H2: The abnormal volume hypothesis - short term traders focused on the impact of the dividend should make the price ratio equal to one.	Failed	Failed
H3: The dividend yield hypothesis - the price ratio should move towards one when the dividend yield increases on the SSE.	Failed	Validated
H4: The price discreetness hypothesis - the price ratio should be significantly lower for shares with dividends that are not exact multiples of the tick size.	Failed	Validated
H5: The bid-ask bounce hypothesis - the price ratio should move towards one when the spread decreases on the SSE.	Failed	Inconclusive
H6: The momentum hypothesis – significant positive (negative) momentum should decrease (increase) the ex-day price ratio.	Inconclusive	Failed

We could clearly reject the differential taxes hypothesis in the univariate level and hence we concentrate on the five other hypotheses in the multivariate analysis. The inconclusive results from the test of the bid-ask bounce hypothesis is due to the fact that the spread variable potentially proxies for two factors simultaneously. We use it as a proxy for the magnitude of the impact of the bid-ask bounce, but it also picks up the impact of transaction costs in general. From the regression it is clear that the spread is able to explain a significant part of the variation in the price ratio. However, we are not able to distinguish the impact between the bid-ask bounce and the transaction costs. Therefore, the test of the bid-ask bounce hypothesis is inconclusive.

6.6 INTERACTION EFFECTS

In order to test the implications of our findings in the empirical analysis, we select a sample consisting of the dividends that are not affected by price discreetness, and simultaneously are in both the highest dividend yield quartile and the lowest spread quartile (which we denote the 'friction free' observations). The 95 resulting observations in the sample constitute the observations that dividend-motivated traders should focus on. Hence, according to our findings, these should have price ratios close to one. As seen in table 6.6.1 the interaction effect is strong on the SSE. For observations where dividend-capturing trading is least risky the price ratios closely follow the differential taxes explanation. We cannot reject that the average price ratio or average market adjusted price ratio is equal to one. The variables that we have identified as important determinants of the price ratio on the SSE seem to be exhaustive. The remaining deviation is small enough to represent normal firm-specific noise. The efficiency of the 'friction free' observations strengthens the findings in our study and indicates that the ex-day day share price behaviour on the SSE is in fact efficient, despite being less than one on average. The conclusion is that the empirical average price ratio is found to be below one because investors demand compensation for the risks and costs associated with trading around the ex-day.

Table 6.6.1: Summary descriptives of 'friction free' observations

	Price ratio	**Adjusted price ratio**	**Dividend yield**
Average	0.97	0.98	0.07
Median	1.00	1.02	0.06
Min	-0.20	-0.30	0.04
Max	3.00	2.75	0.27
St.dev.	0.48	0.48	0.04

7 CONCLUSION

We have in this study investigated what happens to a company's share price on the day when the dividend right is separated. Our study shows that the price ratio on the SSE follows the international pattern and is on average less than one. This is evidence that the differential taxes explanation cannot fully explain the ex-day share price behaviour on the SSE. We therefore investigate other potential explanations for why the price ratio differs from one in the Swedish case.

We find that there are three main factors, besides taxes, that investors take into consideration when they trade around the ex-day on the SSE. First, investors seem to value the potential gains from dividend-capturing trading lower than the risks associated with the lower dividend yield shares. For low dividend yields the un-diversifiable firm-specific risks tend to dominate the gains from exploiting a potential mispricing. Second, we have found evidence that price discreetness significantly impacts the price ratio. For dividend payments where the dividend amount is not an exact multiple of the tick size, investors adjust the ex-day share price downwards by less compared to dividend payments where price discreetness is not an issue. Third, transaction costs lower the efficiency of the price ratio. We have found a distortive effect from transaction cost on the price ratio, but we are not able to disentangle the effects from more general transaction cost from the bid-ask bounce effect. Transaction costs are an important factor to consider, and a better test of the bid-ask bounce could help to further explain why the average price ratio on the SSE is significantly lower than one.

We fail to confirm any impact from the two other factors included in our study - abnormal volume and share price momentum around the ex-day. We found that there is abnormal volume for approximately 18% of our observations, but we could not detect a significant impact on the price ratio. Neither could we find any support for the importance of share price momentum in determining the price ratio.

For investors on the SSE there are two main implications of our study. First, the ex-day share price adjustment is efficient when noise, firm-specific risks and trading costs are considered. Second, there are no risk-adjusted benefits on average from dividend-capturing trading in shares; however, there could still be opportunities for arbitrage profits by trading in derivatives which are priced using an implied price ratio of one. By trading in derivatives, investors can exploit that the average price ratio is less than one, without being restricted by price discreetness and trading costs related to the trading in the underlying shares.

7.1 DISCUSSION OF ROBUSTNESS

Share price changes are inherently hard to predict, therefore we are careful to make sure that our findings are robust. First, in the univariate analysis we have used four samples to investigate the price ratio; the original sample, and the three extensions, where we have trimmed and market adjusted the price ratios. For the abnormal trading and momentum effects, we have included different cut-off levels as well as different significance levels to make sure the findings are consistent.

The analysis is further done using both a univariate and a multivariate approach. The findings in the univariate analysis are the basis for how we structure our regression. The results are broadly consistent and already in the univariate analysis we found signs of the results we could confirm using the more refined multivariate analysis. Since we have used an exhaustive sample for a five year time period and as our main findings are consistent throughout, we believe our results are robust. Therefore, it should be possible to generalize our findings on the SSE for future time periods under the same institutional setting.

7.2 SUGGESTIONS FOR FURTHER STUDIES

In this thesis we have created a database of price ratios that can be used for further studies of the ex-day share price behaviour on the SSE. In a further study it would be interesting to investigate how the release of new material information on the AGM impacts the price ratio. A qualitative study should reveal if there is a significant impact from such observations. Further, a more detailed analysis of the bid-ask bounce effect could potentially detect a difference between general transaction costs and bid-ask bounce effects on the price ratio. Finally, a study of the pricing of derivates on dividend paying shares on the SSE might reveal if our suggested arbitrage strategy is profitable for investors to engage in.

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9 APPENDIX

A. EXAMPLE OF A NON-CASH DIVIDEND ADJUSTMENT

We exemplify with the 2003 dividend from Volvo that had two parts, both a cash dividend of 8.00 SEK per share and a non-cash distribution of shares in Ainax. For every 31 shares of Volvo 2 shares were awarded in the newly created company Ainax, which was created by Volvo as a way to divest its shares in Scania after the failed acquisition in 1999.

There were 27,320,838 shares outstanding in Ainax, of which 27,060,958 were distributed in the 2003 dividend to the shareholders of Volvo. The assets of Ainax constituted of 27,320,838 Scania A shares and cash of 100 MSEK. The theoretical value per share of Ainax was therefore:

The closing price of Scania A on the ex-day, 2004-05-27, was 226.00 SEK. The total value of Ainax was hence:

$$V(Ainax) = 226 \cdot 27{,}320{,}838 + 100{,}000{,}000 = 6{,}274{,}509{,}388 \text{ SEK}$$

This implies a value per share of:

$$V(Ainax) = {}^{6{,}274{,}509{,}388}\!\!\diagup_{27{,}320{,}838} = 229.66 \text{ SEK per share}$$

However, the upcoming dividend of 6.00 SEK from Scania would not be attributable to the owners of Ainax, lowering the value per share to:

$$V(Ainax\_pershare) = 229.66 - 6.00 = 223.66 \text{ SEK per share}$$

The total value of the 2003 dividend in Volvo was therefore:

$$Div_{2003} = 8.00 + {}^{223.66 \cdot 2}\!\!\diagup_{31} = 22.43 \text{ SEK per share}$$

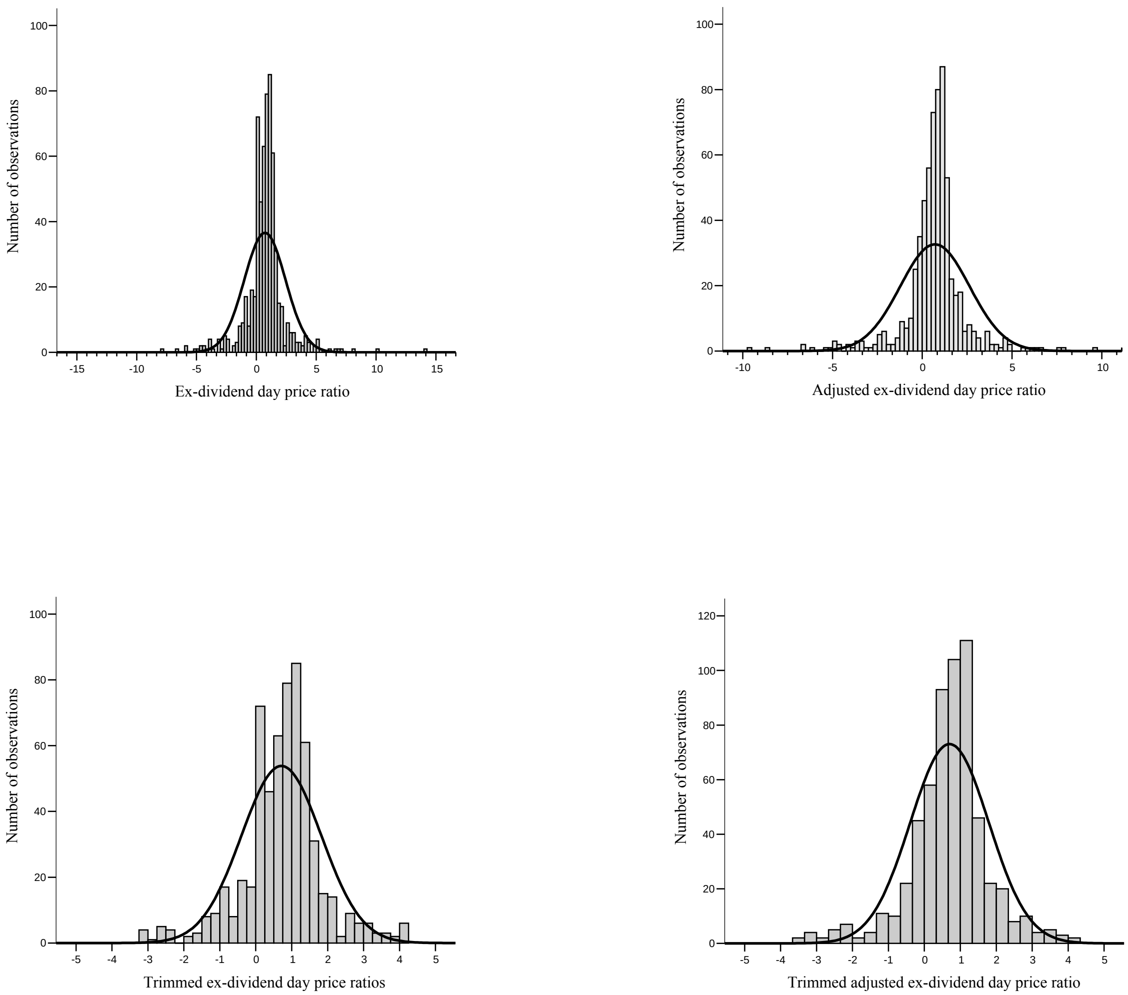
Source: Volvo's 2003 Annual Report (p.84 for dividend from Scania not attributable to Ainax).

B. FIGURES

Figure B.1

Distribution of the price ratios

Figure B.1 displays the distributions of the price ratios in our four samples. The price ratios are divided into intervals of 0.25, plotting the frequency of observations on the vertical axis for each interval. As seen in the graphs the distributions are not normal, but the more adjustments that are done to the samples the more the distributions of the price ratios seem to conform to the normal distribution. In all the four samples we do, however, see a clear clustering around 0.5-1.5, with a significant number of outliers.



C. TABLES

Table C.1
Outliers excluded in the trimming of the original sample

Company	Year	Div	PR	Div.yield	Company	Year	Div	PR	Div.yield
Positive outliers					*Negative outliers*				
Skandia	2000	0.60	14.17	0.0058	Autoliv	2002	1.11	-3.59	0.0047
Poolia	2001	0.25	10.00	0.0050	Novotek	2001	0.50	-3.80	0.0370
Westergyllen	2004	1.25	8.00	0.0114	Kinnevik	2004	0.25	-4.00	0.0041
Note	2004	0.50	7.00	0.0085	Sectra	2002	0.50	-4.00	0.0112
Nobel Biocare	2003	5.00	6.8	0.0049	Nolato	2002	0.50	-4.00	0.0152
Kinnevik	2001	2.00	6.50	0.0057	Observer	2002	0.45	-4.22	0.0224
Sectra	2003	0.50	6.00	0.0079	C F Berg	2001	0.25	-4.40	0.0197
Xano	2001	1.80	5.28	0.0226	Observer	2000	0.45	-4.44	0.0044
Fabege	2004	6.50	5.00	0.0372	Securitas	2000	1.20	-4.58	0.0062
Skandia	2001	0.30	5.00	0.0057	Autoliv	2002	1.17	-4.70	0.0052
Kinnevik	2000	1.00	5.00	0.0013	AudioDev	2000	0.20	-5.00	0.0048
Orc Software	2000	1.40	5.00	0.0077	C F Berg	2000	0.25	-5.20	0.0236
Astra Zeneca	2003	2.07	4.83	0.0060	Biacore	2002	3.00	-5.83	0.0197
Unibet	2004	9.00	4.78	0.0109	Prevas	2000	0.50	-6.00	0.0079
Assa Abloy	2000	0.90	4.44	0.0052	Astra Zeneca	2001	2.44	-6.56	0.0051
Mekonomen	2004	2.30	4.35	0.0141	Astra Zeneca	2000	4.49	-7.91	0.0109

Table C.2
Test if the average price ratio is equal to one

Table C.2 illustrates the results of the test of whether the price ratio is equal to one in our four samples. We test at the 5% significant level that the price ratio is equal to one. The null hypothesis is that the price ratio is equal to one and the alternative hypothesis that the price ratio is different from one. Since n > 30 we use the central limit theorem to test the statistics.

H_0: PR = 1
H_1: PR ≠ 1

Test statistic: $$Z = \frac{AR - 1}{\sigma_{AR} / \sqrt{n}}$$

Reject the null hypothesis if $|Z_{obs}| > |Z_{crit}| = 1.9600$

Sample	Critical value	Test statistic	p-value	Reject
Unadjusted	-1.9600	-4.1488	<0.0001	Yes
Unadjusted and trimmed	-1.9600	-6.3068	<0.0001	Yes
Market adjusted	-1.9600	-3.8526	<0.0001	Yes
Market adjusted and trimmed	-1.9600	-6.7093	<0.0001	Yes

Table C.3
Test of abnormal trading and the relationship with dividend yields

First we test for the existence of abnormal trading around the ex-day for each observation and second we test for the difference in dividend yields in the groups with and without abnormal trading. The test for abnormal trading is done for both the 5% and 10% significance levels and we test at the 2.5% and 5% significance levels if the average dividend yield is higher in the group with abnormal trading than in the group without abnormal trading. For the first test of abnormal trading the null hypothesis is that there is no abnormal trading and the alternative hypothesis that there is abnormal trading. For the second test the null hypothesis is that the dividend yields are equal in the two groups, and the alternative hypothesis is that the dividend yield is higher in the group with abnormal trading. Since n > 30 we use the central limit theorem to test the statistics.

First test of abnormal trading:
H_0: t = 0
H_1: t > 0

Test statistic: $$\widehat{t} = \frac{\left(\sum_{t=1}^{T} SAV_t\right) \Big/ T}{\sigma(\overline{SAV})}$$

Reject the null hypothesis if $|t_{obs}| > |t_{crit}|$ = 1.9600 for the 2.5% level and 1.6449 for the 5% level

Second test of difference in dividend yield:
H_0: $Div.yield_{ABVOL} - Div.yield_{NOABVOL} = 0$
H_1: $Div.yield_{ABVOL} - Div.yield_{NOABVOL} > 0$

Test statistic: $$Z = \frac{Div.yield_{ABVOL} - Div.yield_{NOABVOL} - 0}{\sqrt{\frac{\sigma^2_{ABVOL}}{n_{ABVOL}} + \frac{\sigma^2_{NOABVOL}}{n_{NOABVOL}}}}$$

Reject the null hypothesis if $Z_{obs} > Z_{crit}$ = 1.9600 for the 2.5% level and 1.6449 for the 5% level

Abnormal volume 10% level	No. of observations	Avg. div. yield	St.dev.
No Abnormal Volume	496	3.27%	2.75%
Abnormal Volume	136	4.14%	3.12%

Abnormal volume 5% level	No. of observations	Avg. div. yield	St.dev.
No Abnormal Volume	519	2.93%	1.63%
Abnormal Volume	113	4.25%	3.33%

Sample	Sig. level	Critical value	Test statistic	Reject
Abnormal volume 10% level	2.5%	1.96	2.93	Yes
Abnormal volume 10% level	5%	1.6449	2.93	Yes
Abnormal volume 5% level	2.5%	1.96	4.09	Yes
Abnormal volume 5% level	5%	1.6449	4.09	Yes

Table C.4
Test of difference in price ratios in the groups with and without abnormal trading

We illustrate the results of the test of difference in price ratios in the two groups, with and without abnormal trading (using the 5% cut-off level to determine abnormal trading). We test at the 2.5% and 5% significance levels if the average price ratio is higher in the group with abnormal trading compared to the group without abnormal trading. The null hypothesis is that the price ratios are equal in the two groups, and the alternative hypothesis is that the price ratio is higher in the group with abnormal trading. Since n > 30 we use the central limit theorem to test the statistics.

H_0: $PR_{ABVOL} - PR_{NOABVOL} = 0$
H_1: $PR_{ABVOL} - PR_{NOABVOL} > 0$

Test statistic: $$Z = \frac{PR_{ABVOL} - PR_{NOABVOL} - 0}{\sqrt{\frac{\sigma^2_{ABVOL}}{n_{ABVOL}} + \frac{\sigma^2_{NOABVOL}}{n_{NOABVOL}}}}$$

Reject the null hypothesis if $Z_{obs} > Z_{crit}$ = 1.9600 for the 2.5% level and 1.6449 for the 5% level

Original sample	No. of observations	Avg. PR	St.dev.
No Abnormal Volume	519	0.7445	1.7591
Abnormal Volume	113	0.5817	1.5554

Trimmed and market adj. sample	No. of observations	Avg. PR	St.dev.
No Abnormal Volume	471	0.6734	1.1413
Abnormal Volume	129	0.8004	0.8896

Sample	Sig. level	Critical value	Test statistic	Reject
Original sample	2.5%	1.96	-0.98	No
Original sample	5%	1.6449	-0.98	No
Trimmed and market adj. sample	2.5%	1.96	1.35	No
Trimmed and market adj. sample	5%	1.6449	1.35	No

Table C.5
Impact of dividend yields on the price ratio

In table C.5 we have split the trimmed and adjusted price ratio data set in quartiles based on the dividend yield, where Q1 is the quartile with the lowest dividend yield and Q4 the one with the highest. The market frictions should be lower in the fourth quartile and the dividend capturing behaviour should drive the price ratio towards one. The hypothesis is consistent with the results, as we can identify an average abnormal price ratio that gets closer to one from Q2 and onwards. We also see a clear linear decrease in the standard deviations. In Q1 the low average dividend yield indicates that the impact of the dividends in question are small compared to other benefits of share ownership and could therefore be largely ignored by investors.

Quartile	No. of observations	Average dividend yield	Average PR	Standard deviation
Q1	158	1.05%	0.76	2.96
Q2	158	2.48%	0.46	1.41
Q3	158	3.69%	0.72	0.90
Q4	158	6.61%	0.92	0.53

Table C.6
Test of difference in price ratios between the first and fourth quartiles sorted by dividend yields

In table C.6 we illustrate the results of the test of difference between price ratios in the two extreme groups, the fourth and first quartiles. We test at the 2.5% and 5% significance levels if the average price ratio is larger in the fourth quartile than in the first. The null hypothesis is that the price ratios are equal in the two samples, and the alternative hypothesis is that the price ratios are larger in the fourth quartile. Since n > 30 we use the central limit theorem to test the statistics.

$$H_0: PR_{Q4} - PR_{Q1} = 0$$
$$H_1: PR_{Q4} - PR_{Q1} > 0$$

Test statistic: $$Z = \frac{PR_{Q4} - PR_{Q1} - 0}{\sqrt{\frac{\sigma_{Q4}^2}{n_{Q4}} + \frac{\sigma_{Q1}^2}{n_{Q1}}}}$$

Reject the null hypothesis if $Z_{obs} > Z_{crit} = 1.9600$ for the 2.5% level and 1.6449 for the 5% level

Significance level	Critical value	Test statistic	Reject
2.5%	1.96	0.65	No
5%	1.6449	0.65	No

Table C.7
Price discreetness impact on the price ratio

We illustrate the results of the test of difference between price ratios in the two groups, with and without impact from tick sizes. As commented on in the text, we chose to define impact from tick sizes as the observations where the dividend is not an exact multiple of the tick size. The dummy takes the value of 1 if there is an impact and 0 otherwise. We test at the 2.5% and 5% significant levels if the average price ratio is lower in the group with impact from tick sizes compared to the group without impact from tick sizes. The null hypothesis is that the price ratios are equal in the two groups, and the alternative hypothesis is that the price ratio is lower in the group with impact from tick sizes. Since n > 30 we use the central limit theorem to test the statistics.

H_0: $PR_{TICK} - PR_{NOTICK} = 0$
H_1: $PR_{TICK} - PR_{NOTICK} < 0$

Test statistic: $$Z = \frac{PR_{TICK} - PR_{NOTICK} - 0}{\sqrt{\frac{\sigma^2_{TICK}}{n_{TICK}} + \frac{\sigma^2_{NOTICK}}{n_{NOTICK}}}}$$

Reject the null hypothesis if $Z_{obs} > Z_{crit} = -1.9600$ for the 2.5% level and -1.6449 for the 5% level.

Original sample	No. of observations	Avg. PR	St.dev.
Dummy = 1	186	0.650	2.11
Dummy = 0	446	0.743	1.54

Trimmed market adj. sample	No. of observations	Avg. PR	St.dev.
Dummy = 1	174	0.628	1.24
Dummy = 0	426	0.731	1.03

Sample	Sig. level	Critical value	Test statistic	Reject
Original sample	2.5%	-1.96	-0.54	No
Original sample	5%	-1.6449	-0.54	No
Trimmed market adj. sample	2.5%	-1.96	-0.97	No
Trimmed market adj. sample	5%	-1.6449	-0.97	No

Table C.8
Spread impact on the price ratio

In table C.8 we have split our original and trimmed market adjusted samples in quartiles based on the spread, where Q1 is the quartile with the highest spread and Q4 the one with the lowest. The market frictions should be lower in the fourth quartile and the price ratio should move towards one. The hypothesis is consistent with the results, as we can identify an average price ratio that gets closer to one from Q2 and onwards. We also see a clear linear decrease in the standard deviations.

Original sample

Quartile	No. of observations	Average spread	Average PR	Standard deviation
Q1	158	0.34	0.71	2.91
Q2	158	0.14	0.58	1.49
Q3	158	0.09	0.71	0.93
Q4	158	0.05	0.88	0.60

Trimmed adjusted sample

Quartile	No. of observations	Average spread	Average PR	Standard deviation
Q1	150	0.30	0.71	1.67
Q2	150	0.13	0.61	1.03
Q3	150	0.09	0.62	0.79
Q4	150	0.05	0.87	0.52

Below we illustrate the results of the test of difference in price ratios in the two extreme groups, the fourth and first quartiles. We test at the 2.5% and 5% significant levels if the average price ratio is higher in the fourth quartile than in the first. The null hypothesis is that the average price ratios are equal in the two samples, and the alternative hypothesis is that the price ratios are larger in the fourth quartile. Since n > 30 we use the central limit theorem to test the statistics.

$$H_0: PR_{Q4} - PR_{Q1} = 0$$
$$H_1: PR_{Q4} - PR_{Q1} > 0$$

Test statistic: $$Z = \frac{PR_{Q4} - PR_{Q1} - 0}{\sqrt{\frac{\sigma_{Q4}^2}{n_{Q4}} + \frac{\sigma_{Q1}^2}{n_{Q1}}}}$$

Reject the null hypothesis if $Z_{obs} > Z_{crit}$ = 1.9600 for the 2.5% level and 1.6449 for the 5% level

Sample	Sig. level	Critical value	Test statistic	Reject
Original sample	2.5%	1.96	0.72	No
Original sample	5%	1.6449	0.72	No
Trimmed market adj. sample	2.5%	1.96	1.12	No
Trimmed market adj. sample	5%	1.6449	1.12	No

Table C.9
Impact from share price momentum on the price ratio

We illustrate the results of the test of difference in price ratios in the two groups, with and without impact from positive and negative momentum effects. We test at the 2.5% and 5% significance levels, first if the average price ratios are lower in the group with impact from positive compared to the group without momentum effects (excluding the observations with negative momentum effects) and secondly if the average price ratios are higher in the group with impact from negative momentum compared to the group without momentum effects. The null hypothesis is that the price ratios are equal in the two groups, and the alternative hypothesis is that the price ratios are lower in the group with positive momentum. The second null hypothesis is that the price ratios are equal in the two groups, and the alternative hypothesis is that the price ratios are higher in the group with negative momentum. Since n > 30 we use the central limit theorem to test the statistics.

$$H_0\text{: }_{\text{POSITIVE MOMENTUM}} - PR_{\text{NO MOMENTUM}} = 0$$
$$H_1\text{: }_{\text{POSITIVE MOMENTUM}} - PR_{\text{NO MOMENTUM}} < 0$$

$$H_0\text{: } PR_{\text{NEGATIVE MOMENTUM}} - PR_{\text{NO MOMENTUM}} = 0$$
$$H_1\ PR_{\text{NEGATIVE MOMENTUM}} - PR_{\text{NO MOMENTUM}} > 0$$

Test statistic:
$$Z = \frac{PR_{\text{MOMENTUM}} - PR_{\text{NO MOMENTUM}} - 0}{\sqrt{\frac{\sigma^2_{\text{MOMENTUM}}}{n_{\text{MOMENTUM}}} + \frac{\sigma^2_{\text{NO MOMENTUM}}}{n_{\text{NO MOMENTUM}}}}}$$

For the positive (negative) momentum: reject the null hypothesis if $Z_{obs} > Z_{crit}$ = 1.9600 (-1.9600) for the 2.5% level and 1.6449 (-1.6449) for the 5% level.

Sample	No. of observations	Average PR	Standard deviation	Test statistic	Reject
Cut-off _Momentum	*D =1 / Neutral*	*D =1 / Neutral*	*D = 1 / Neutral*	*Z*	*5% / 2.5%*
5%_Positive	110 / 474	0.44 / 0.75	1.27 / 1.67	2.80	Yes / Yes
5%_Negative	48 / 474	1.01 / 0.75	2.83 / 1.67	-0.64	No / No
7.5%_Positive	54 / 554	0.37 / 0.78	1.46 / 1.70	1.89	Yes / No
7.5%_Negative	24 / 554	0.11 / 0.78	2.58 / 1.70	1.25	No / No
5%_Positive_Adj	107 / 453	0.70 / 0.70	0.95 / 1.10	0.00	No / No
5%_Negative_Adj	40 / 453	0.68 / 0.70	1.32/1.10	0.11	No / No
7.5%_Positive_Adj	51 / 530	0.74 / 0.71	0.86 / 1.09	1.21	No / No
7.5%_Negative_Adj	19 / 530	0.36 / 0.71	1.57 / 1.09	0.43	No / No

Table C.10

Tick sizes on the Stockholm Stock Exchange

The trading rules on the SSE specify a smallest possible increment of a bid or ask price, the so called tick size. The tick size of a specific share depends on its current price as specified in the table below. We have used these current intervals for the whole sample period.

Price intervals (SEK)	Tick size
0.00 – 4.99	0.01
5.00 – 14.95	0.05
15.00 – 49.90	0.10
50.00 – 99.75	0.25
100 – 499.50	0.50
500.00 – 4999.00	1.00
> 5000.00	5.00

Source: Aktiedirekt, 'Information on trading'

Table C.11

Summary table of dummy variables

Variable	No. of observations	Portion of sample
Tick size	187	30%
Abnormal volume (10% sign)	137	22%
Abnormal volume (5% sign)	114	18%
Pos_mom_5 days *(5% / 7.5%)*	110 / 54	17% / 9%
Pos_mom _10 days	17	2.7%
Pos_mom _30 days	31	4.9%
Pos_mom _60 days	50	7.9%
Neg_mom _5 days *(5% / 7.5%)*	48 / 24	7.6% / 3.8%
Neg_mom _10 days	8	1.3%
Neg_mom _30 days	8	1.3%
Neg_mom _60 days	6	1.0%

D. REGRESSION RESULTS

Table D.1

Hausman test results

The output tables below are STATA print-outs of the Hausman specification test results we perform on the original and trimmed samples. Since we are not able to reject the null hypothesis that there is correlation between the unobserved person-specific random effects and the regressors, we can conclude for both tests that we are able to use the random effects, instead of the fixed effects.

STATA Hausman Test: Price ratio - original sample

	Coefficients			
	(b) Fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
Divyield	2.541712	3.918741	-1.37703	2.166637
Dummytick	-0.1897237	-0.1103498	-0.0793739	0.0920178
Volume	0.0153469	0.0152431	0.0001038	0.0713227
Pos_mom_5	-0.1782153	-0.1309522	-0.0472631	0.0957932
Neg_mom_5	0.2217614	0.0597162	0.162045	0.1917697
dummydivyield	0.4740748	0.4654728	0.008602	0.1476946
ddivyield	-4.772422	-4.699166	-0.0732567	2.499277
market	-0.200659	-0.1981265	-0.0025325	0.0191218
spread	-3.943856	-4.384571	0.4407149	0.3854028
dspread	11.27218	11.31694	-0.0447598	0.4038977

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= (b-B)'[(V_b-V_B)^(-1)](b-B)
= 4.28
Prob>chi2 = 0.9339

STATA Hausman Test: Price ratio - trimmed sample

	Coefficients			
	(b) Fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
Divyield	2.781444	3.806707	-1.025262	1.575358
Dummytick	-0.1571437	-0.1150036	-0.0421401	0.0706891
Volume	-0.0290551	-0.005513	-0.0235421	0.0542853
Pos_mom_5	-0.0291735	-0.0427611	0.0135877	0.0710212
Neg_mom_5	0.023052	0.0195208	0.0035313	0.1436467
dummydivyield	0.9393345	1.01122	-0.071886	0.126647
ddivyield	-6.836498	-7.2085	0.3720012	1.921723
market	-0.0849271	-0.1240747	0.0391476	0.0254221
spread	-3.184289	-2.759486	-0.4248033	0.4069678
dspread	5.787057	5.620515	0.1665419	0.4855393

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2(10) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 6.25
Prob>chi2 = 0.7941

Table D.2

Regression results

In table D.2 we present the results from our regression study. We provide STATA outputs on both the original and the trimmed sample. In order to get unique observations for each time unit (each year) 22 observations are eliminated from the main sample, representing semi-annual dividends paid from Autoliv, Astra Zeneca and Tieto Enator. Therefore, our original sample collapses to 610 observations and the adjusted sample is trimmed with 5% to 580 observations.

Stata random-effects regression output: Price ratio - original sample

Random-effects GLS regression		Number of obs = 610
Group variable (i): code		Number of groups = 151
R-sq:	within = 0.6009	Obs per group: min = 1
	between = 0.5944	avg = 4.0
	overall = 0.5888	max = 6

pr	Coef.	Std. Err.	z	P>|z|	[95% Conf. int.]	
Divyield	3.918741	2.613378	1.50	0.134	-1.203385	9.040868
Dummytick	-0.1103498	0.1076191	-1.03	0.305	-0.3212794	0.1005798
Volume	0.0152431	0.1117105	0.14	0.891	-0.2037055	0.2341917
Pos_mom_5	-0.1309522	0.2064827	-0.63	0.526	-0.5356509	0.2737466
Neg_mom_5	0.0597162	0.307127	0.19	0.846	-0.5422416	0.661674
dummydivyield	0.4654728	0.2307051	2.02	0.044	0.0132992	0.9176465
ddivyield	-4.699166	3.593745	-1.31	0.191	-11.74278	2.344446
market	-0.1981265	0.0373323	-5.31	0.000	-0.2712966	-0.1249565
spread	-4.384571	0.5339582	-8.21	0.000	-5.43111	-3.338032
dspread	11.31694	0.7453325	15.18	0.000	9.856114	12.77776
_cons	0.5339737	0.1603626	3.33	0.001	0.2196689	0.8482786

Stata random-effects regression output: Price ratio - trimmed sample

Random-effects GLS regression		Number of obs = 580	
Group variable (i): code		Number of groups = 149	
R-sq:	within = 0.5507	Obs per group:	min = 1
	between = 0.6304		avg = 3.9
	overall = 0.5869		max = 5

pr	Coef.	Std. Err.	z	P>|z|	[95% Conf. int.]	
Divyield	3.806707	1.718432	2.22	0.027	0.4386425	7.174771
Dummytick	-0.1150036	0.0690822	-1.66	0.096	-0.2504023	0.020395
Volume	-0.005513	0.072636	-0.08	0.939	-0.1478769	0.1368509
Pos_mom_5	-0.0427611	0.1365218	-0.31	0.754	-0.3103389	0.2248166
Neg_mom_5	0.0195208	0.2152506	0.09	0.928	-0.4023626	0.4414042
dummydivyield	1.01122	0.1701561	5.94	0.000	0.6777207	1.34472
ddivyield	-7.2085	2.412933	-2.99	0.003	-11.93776	-2.479238
market	-0.1240747	0.0375036	-3.31	0.001	-0.1975805	-0.050569
spread	-2.759486	0.4370192	-6.31	0.000	-3.616028	-1.902944
dspread	5.620515	0.6752887	8.32	0.000	4.296974	6.944057
_cons	0.4641093	0.1113132	4.17	0.000	0.2459394	0.6822793