INCIDENCE, DETERMINANTS AND OPPORTUNITIES OF EX-DIVIDEND DAY ANOMALY: EVIDENCE FROM NORDIC MARKETS

Lappeenranta–Lahti University of Technology LUT

Master’s Programme in Strategic Finance and Business Analytics, Master's thesis

2022

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ABSTRACT

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Incidence, Determinants and Opportunities of Ex-Dividend Day Anomaly: Evidence from Nordic Markets

Master's thesis

2022

83 pages, 6 figures, 15 tables and 7 appendices

Examiners: Associate Professor Sheraz Ahmed and Professor Eero Pätäri

Keywords: Ex-dividend day, Abnormal returns, Anomaly, Dividend

This thesis is intended to examine the stock price behaviour on and around the ex-dividend day at Nordic stock market between 2005 and 2019. Theoretically, assuming efficient market conditions, the price drop on ex-dividend day should be equal to the dividend. However, according to the consensus of previous literature around the world, the price drop on ex-dividend day is usually less than the amount of dividend. The goal of this study is to investigate, whether such anomaly exists at Nordic stock markets, which factors affect on the magnitude of the price drop and above all, how could investors benefit from such market inefficiency.

Both event-study methodology and cross-sectional regression analysis are used to investigate the ex-day price behaviour. The results indicate that in Nordics, the ex-dividend day anomaly occurs with highest magnitude in Denmark, where on average the ex-day price drops are well below the dividend. On the other hand, markets are most efficient in Sweden where chances to benefit from the ex-dividend day anomaly are lowest. The stock price behaviour around ex-dividend day shows signs of investor's desire for dividend income, especially in Finland where stock prices tend to increase significantly for a few days before the dividend detachment. Since stock prices seem to drop less than the amount of dividend, statistically significant positive abnormal returns were observed on ex-day as well. The results from cross-sectional regression show, that dividend yield seems to be negatively related to ex-day excess returns, meaning that price drop is higher when dividend yield is increased.

TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT

LUT-kauppakorkeakoulu

Kauppatieteet

Niko-Pekka Alho

Irtoamispäiväilmiön ilmaantuvuus, mahdollisuudet ja määräävät tekijät pohjoismaisilla osakemarkkinoilla

Kauppatieteiden pro gradu -tutkielma

83 sivua, 6 kuvaa, 15 taulukkoa ja 7 liitettä

Tarkastajat: Apulaisprofessori Sheraz Ahmed ja Professori Eero Pätäri

Avainsanat: Irtoamispäivä, Epänormaalit tuotot, Anomalia, Osinko

Tämän tutkielman tarkoituksena on tutkia osakekurssien käyttäytymistä osingon irtoamisen yhteydessä pohjoismaisilla osakemarkkinoilla vuosien 2005 ja 2019 välillä. Tehokkailla markkinoilla osakekurssien tulisi teoriassa laskea osingon irtoamisen yhteydessä juuri osingon määrän verran. Aiemmat empiiriset tutkimukset eri markkinoilla osoittavat, että yleensä näin ei kuitenkaan ole, vaan osakedippi irtoamispäivänä on yleensä alle osingon määrän. Tämän tutkimuksen tavoitteena on tutkia irtoamispäiväilmiön esiintyvyyttä pohjoismaisilla osakemarkkinoilla sekä ilmiön voimakkuuteen vaikuttavia tekijöitä. Ennen kaikkea tavoitteena on selvittää, missä määrin sijoittajien on mahdollista hyötyä kyseisestä markkinoiden epätäydellisyyden aiheuttamasta ilmiöstä.

Tutkimus toteutettiin käyttäen sekä tapahtumatutkimuksen menetelmiä että lineaarista regressioanalyysia. Tulosten perusteella irtoamispäiväilmiö esiintyy pohjoismaista voimakkaimmin Tanskan osakemarkkinoilla, jossa kurssilasku irtoamispäivänä on keskimäärin selvästi vähemmän kuin osingon verran. Toisaalta osakemarkkinat näyttävät toimivan tehokkaimmin Ruotsissa, jossa sijoittajien mahdollisuudet hyötyä irtoamispäiväilmiöstä ovat heikoimmat. Osakekurssien käyttäytyminen irtoamispäivän ympärillä viittaa siihen, että sijoittajat yleisesti arvostavat osinkoina saamiaan tuottoja. Varsinkin Suomen markkinoilla on havaittavissa tilastollisesti merkitsevää epänormaalia nousua osakekursseissa muutaman päivän ajan ennen osingon irtoamista. Koska irtoamispäivän kurssilasku on keskimärin alle osingon määrän, tilastollisesti merkitseviä positiivisia epänormaaleja tuottoja havaittiin myös irtoamispäivänä. Regressioanalyysin tulosten perusteella erityisesti osinkotuotto näyttäisi vaikuttavan negatiivisesti irtoamispäivän epänormaaleihin tuottoihin, tarkoittaen samalla, että keskimääräinen irtoamispäivän kurssilasku suhteessa osinkoon näyttäisi kasvavan osinkotuoton kasvaessa.

ACKNOWLEDGEMENTS

A 5-year trip has come to an end. It has been an incredible journey. I would like to thank all the amazing people I met during my studies. New friendships were made, and unforgettable moments shared. Thanks for the whole LUT community for making this possible, even under exceptional circumstances during the last two years.

I wish to express a great gratitude to Associate Professor Sheraz Ahmed for all the tips and guidance when writing this thesis.

Above all, I want to thank my family for their constant support throughout the years. Without my parents and their efforts, I would not be where I am now.

Last, I want to thank my lovely girlfriend Verna for always being there for me.

Lappeenranta 17.3.2022
Niko-Pekka Alho

ABBREVIATIONS

AAR	Average abnormal return
BAPDR	Beta-alpha adjusted price drop ratio
CAAR	Cumulative average abnormal return
DY	Dividend yield
EMH	Efficient market hypothesis
EPDR	Expected price drop ratio
MC	Market capitalization
MPDR	Market adjusted price drop ratio
MTB	Market-to-book ratio
PDR	Price drop ratio
RE	Retained earnings
RPDR	Raw price drop ratio
TR	Turnover ratio

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1. Introduction

Generally, anomaly refers to a situation where something seems to deviate from what is considered to be standard. In stock markets, prices of securities do not always develop in a way that is assumed as standard during different time periods or regular events. This violates the assumptions of Efficient Market Hypothesis (EMH), creating chances for investors to trace these abnormalities and possibly gain extra profit. In EMH, it is assumed that prices of securities reflect all available information at the market and therefore anomalies should not exist in any form. In real world, a situation where all players have all relevant information in use and prices reflect this information perfectly is basically impossible to achieve. Hence, anomalies may exist at market indicating that under real world circumstances, EMH does not always hold.

One regular event that may cause anomalies to appear at stock market is the dividend payout. Findings of Fama & French (2001) and DeAngelo, DeAngelo & Skinner (2004) show however, that number of companies paying dividends has decreased over the years. On the other hand, the companies that pay dividends today have a policy to pay relatively high dividend, and despite the decrease in dividend paying tendency, the aggregate dividend paid to shareholders has actually increased. Since dividends paid reduce the wealth of the company paying them, it should also reflect the stock price of the company. By using common sense, it would be reasonable to expect that a dividend of 1 euro would decrease the price of a share with same amount. However, previous studies at the stock markets around the world show that this does not always hold. Most of the studies have been conducted in Northern America, showing some evidence of what is known as ex-dividend day anomaly, meaning that price drop of a share on ex-dividend day does not match the amount of dividend paid. This subject has also been examined in Europe, for example by Dasilas (2009) in Greece and Garcia-Blandon & Martinez-Balsco (2012) in Spain, to mention a few.

First ones to attack the ex-dividend day anomaly were Campbell & Beranek (1955), who noticed that on average, the price drop of a share was 90% of the amount of dividend on ex-dividend day. Since then, numerous other empirical studies have sought to explain this

phenomenon without achieving a clear pattern behind it. Probably the most widely known explanation for price behaviour on ex-dividend day was offered by Elton & Gruber (1970). Their results matched approximately the findings of Campbell & Beranek (1955) about the existence of ex-dividend day anomaly, but they were also the first ones trying to explain the phenomenon. They argued that differences in taxation of dividends and capital gains cause prices to develop in a way that the price drop on ex-dividend day does not match the amount of dividend, causing the ex-dividend day anomaly to exist. Later, some competitive theories have been developed to explain the price behaviour, for example by Kalay (1982) and Dubrofsky (1992).

Since existence of ex-dividend day anomaly may offer a chance on accessing higher returns at stock market, understanding the factors behind it is highly intriguing for active investors especially. Of course, it is impossible to construct such a model that is able to predict the price behaviour of a single stock accordingly in all circumstances. However, estimating the significant factors may offer a chance to predict the price behaviour more accordingly, which in the long run could appear in the form of extra profit around the ex-dividend day. For example, if you know that some characteristics of a stock often lead to higher price drop during dividend payout, you can fit your actions at markets according to the expected outcome. In any case, more precise knowledge on markets and its phenomena is always beneficial.

In this thesis, the aim is to examine the existence of ex-dividend day anomaly at Nordic stock market and provide explanation to the ex-dividend day price behaviour using factors that other studies have found significant, as well as possibly find additional explanatory power from other determinants. In Nordic markets, for example the tax legislation of dividends and capital gains is not similar between countries, which provides interesting framework for testing the model of Elton & Gruber (1970) for instance. To some extent, results should differ between countries with different legislation, if this so-called tax clientele-effect holds. In addition, Nordic markets are way less examined in this sense than markets in Northern America for example, and therefore the possibilities for finding additional explanatory power concerning the determinants of price behaviour on ex-dividend day are higher. Also, due to limited number of previous studies in Nordics the evidence in the region is quite narrow, which is why this paper could, in best case, fill some research gaps also.

1.1 Research objectives

Despite extensive history in ex-dividend day anomaly research, there does not exist one common and universally accepted theory for explaining the price behaviour of a stock during dividend payout. Results seem to vary between markets, and theoretical models like ones created by Elton & Gruber (1970) and Kalay (1982) have received both acceptance and criticism. Illustrative example of the complexity of ex-dividend day price behaviour is the study of Borges (2008), according to which no previously developed model seemed to provide sufficient explanatory power for ex-dividend day price formation. In this study however, the investigation is made from the investor's perspective. Since markets may behave irrationally around the ex-dividend day, possibilities to achieve excess returns at the market may arise. This could be the case for instance if the price drop on ex-dividend day is regularly really low, and differences in capital gain and dividend taxation for example could not explain it. In such case, clever investors could in theory get their hands into arbitrage-like profits, acquiring and selling specified shares at right time. Therefore, the main research question is set as follows:

"Does the stock price behaviour around ex-dividend day open possibilities to achieve excess returns with some trading strategy?"

To dig deeper the main objective, three supportive sub-questions were set in a following way:

"Is the price movement on and around the ex-dividend day different between countries in the region? Does the anomaly appear with different magnitude in different countries?"

"Which company-level factors seem to explain the ex-dividend day price movement at Nordic market?"

"Do differences in dividend and capital gain taxation provide explanatory power in price fluctuation on ex-dividend day?"

The purpose of the first sub-question is to provide the answer, whether stock markets in different Nordic countries act differently around ex-dividend day. If the anomaly appears

systematically differently in different markets throughout the investigation period, it can be assumed that there is difference on ex-dividend day price behaviour between countries in the region. Second sub-question is set to detect the company-level factors that explain the price drop on ex-dividend day at given markets, but mostly focusing on financial characteristics. Third sub-question is intended to provide an answer whether the framework created by Elton and Gruber (1970) is applicable in Nordic markets. Despite being the most commonly known theory, it has received criticism and had conflicting evidence in latter literature. If taxation seems not to provide explanatory power in this paper, naturally the focus will be transferred to capture the factors that do, like stated in second sub-question. An example of such factor is the current dividend yield of a stock, which according to for instance Boyd & Jagannathan (1994) is related to price drop on ex-dividend date. In addition, it can be observed whether investors seem to act in a way that they try to capture dividends and wish to receive them. If so, it is assumed that stock returns before ex-dividend day would most likely be positive.

1.2 Research structure

This paper begins with introductory section, where the main purpose is to introduce the topic to reader and set objectives and research questions for the paper. In second stage, focus is transferred to theoretical framework around the ex-dividend day anomaly and dividend payout policy on general level. Also, target is to clarify some technical and legislative factors related to dividends, as well as clear up some relevant concepts concerning this research. Third step is to get acquainted with findings of earlier literature about the anomaly. Previous studies and their findings will be reviewed, and theories explaining the ex-dividend day anomaly will be explored in more detail.

Fourth step in this paper is the empirical section. This section begins with introducing and describing the sample used, followed by presenting the research methods of the paper. After this stage, the results observed will be analyzed and reported. The aim of the empirical section is to provide answers to research questions set in section 1.2. In last section, conclusions will be made concerning the results observed and success of the study. The structure of the study is presented in a graphical form in figure 1.

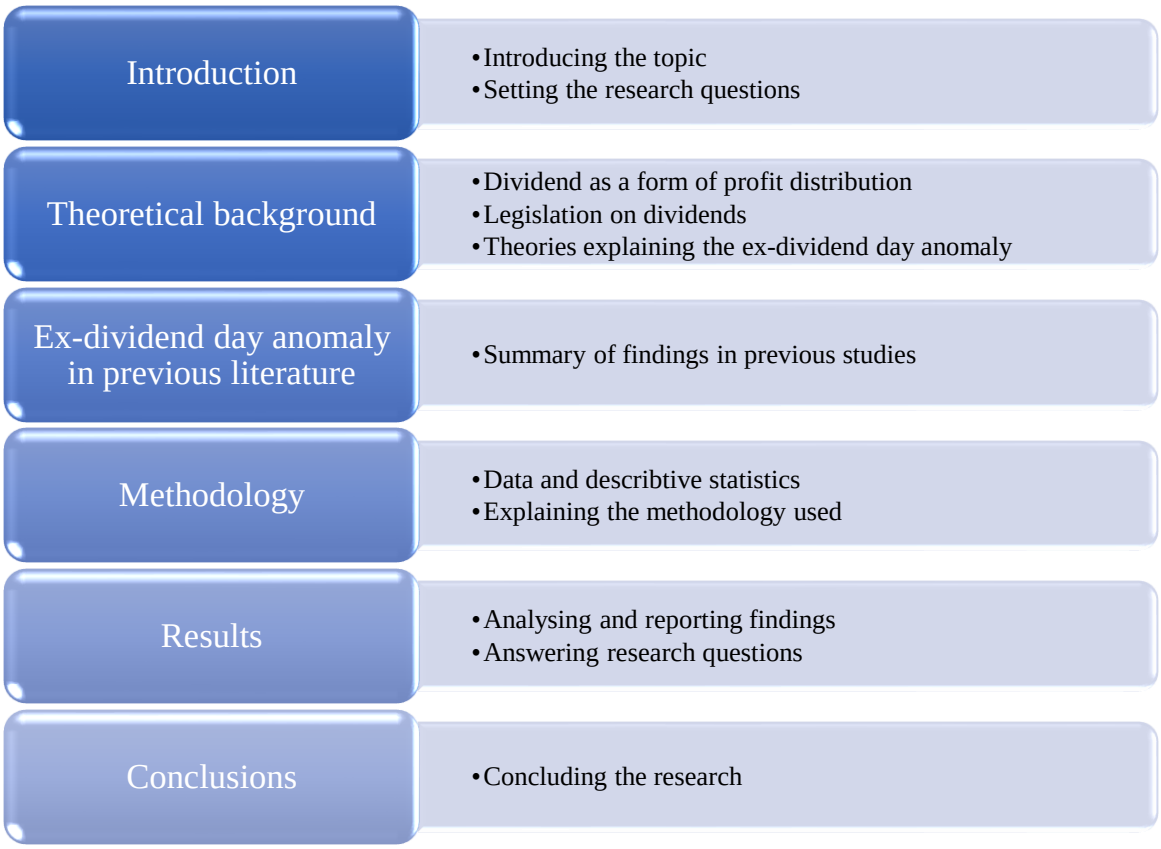

Figure 1: Structure of the research

1.3 Limitations

This thesis has some limitations that need to be taken into account when interpreting the results. First, this study is conducted at Nordic markets, which affects its broad application. Every market has some unique characteristics, which may influence on results obtained. For example, in terms of market accessibility and legislation, different market areas are not fully comparable. Secondly, this analysis is based on historical performance, which is not a guarantee on future development.

This study is intended to provide holistic view on ex-day price formation, as well as factors that influence the price movements on ex-day. Under real world circumstances ancillary

costs from investment activities would occur and thus possibly change the results. This needs to be taken into account when utilizing the findings in practice.

2. Theoretical background

There are multiple essential details and concepts related to the dividend payment. When examining the ex-dividend day anomaly, relevant regulatory factors such as taxation of dividends should be understood. In this section, the intention is to provide a theoretical framework on why companies in general pay dividends, and what kind of effects it may have. Also, the key legislative factors related to dividends are examined. Last, the theoretical background concerning the ex-dividend day anomaly is introduced.

2.1 Dividend policy

Dividend policy has been widely investigated throughout the history. However, the research has not reached a consensus whether dividend policy affects long-term share prices of dividend paying company. There are many competitive and also complementary theories to explain, why companies pay dividends and what are the determinants for the amount of dividend paid. Lintner (1956) was one of the first ones to build a theoretical model to explain the corporate dividend behaviour. Lintner's (1956) approach to the problem was behavioural. One of the key arguments of the study was that companies tend to increase dividends when managers assume that the earnings of the company have increased permanently. These increases or adjustments are not dramatic, but managers aim to smoothen the dividends in short run to avoid massive changes between years. This is also related to fact that dividend cuts could affect negatively to the company's stock price. Lintner's (1956) model has been accepted in several papers afterwards. For example, Benartzi, Michaely & Thaler (1997) declared it as the best available description of dividend setting process and Baker & Powell (1999) concluded that findings of Lintner (1956) are applicable still over 40 years later. Similarly, Jose and Stevens (1989) found evidence that in markets steady dividends are valued over steady payout ratio. This is an indicator that investors appreciate steady annual cash flows, which supports the policy to pay dividends. All in all, many factors affect the company's dividend policy, and similarly dividend payments affect the stock price of a company. Next, some of the most common theories

concerning dividend policy are briefly introduced. Target is to figure out, why companies should or should not pay dividends to their shareholders.

2.1.1 Dividend irrelevance hypothesis

The forefathers of dividend irrelevance hypothesis are Miller and Modigliani (1961), who argued that under perfect market conditions, where investors are rational, no transaction costs exist and information is complete, the dividend policy of the company has no effect on shareholder's wealth. Therefore, from the point of view of shareholders, it does not matter whether company pays dividends or not. The base of the argument is that investors calculate the value of the company based on future earnings, and thus it is irrelevant whether these earnings come in a form of dividends or capital gains. This future value is therefore unaffected on any dividend payments. If an investor wishes to receive dividends and the company's policy is not to pay them, Miller & Modigliani (1961) suggest that in such situation investors can create homemade dividends by trading their holdings and this way adjust their portfolio to match the preferences.

Miller & Modigliani (1961) used mathematical expressions to prove their arguments. Under perfect conditions, investors require the rate of return that is equal to the sum of dividends and capital gains.

$$r = \frac{D_t + (P_t - P_0)}{P_0} \quad (1)$$

where $r = \text{Required rate of return}$

$D_t = \text{Dividend at time t}$

$P_t = \text{Stock price at time t}$

$P_0 = \text{Stock price at time 0}$

Rearranging formula 1 the market price of a share can be calculated following way:

$$P_0 = \frac{D_t + P_t}{(1 + r)} \tag{2}$$

The formula above returns the value of individual share. When valuing the whole enterprise, number of shares must be included in the equation. Thus, formula for this purpose can be written as follows:

$$V_0 = nP_0 = \frac{nD_t + nP_t}{(1 + r)} \tag{3}$$

where $V_0 = \text{Value of the company at time } 0$

$n = \text{Number of shares}$

At this point, it seems that value of the enterprise depends on future dividends (D_t) and future stock price (P_t), multiplied by the number of shares (n). However, dividends cannot be paid if there is no source of funding. Miller & Modigliani (1961) argued that two options as funding sources are operational cash flows (X_t) and new equity financing (mP_t), e.g., new shares issued at time t. Depending on chosen policy, a company may use its funds for new investment purposes (I_t) instead for paying dividends. These two factors combined determine, where the funds company has created are used. Since sources and uses of funds must equal, the following equation must hold:

$$X_t + mP_t = nD_t + I_t \tag{4}$$

When rearranging, it can be obtained that

$$nD_t = X_t + mP_t - I_t \tag{5}$$

Formula 5 proves that dividends can be expressed as equation of operative cash flows, new equity financing and investments. Therefore, formula 3 can be rewritten as

$$V_0 = nP_0 = \frac{X_t + mP_t - I_t + nP_t}{(1 + r)} \tag{6}$$

Since formula 6 does not include dividends as variable, and operative cash flow (X_t), investments (I_t) and required rate of return I are all independent on dividends (D), Miller & Modigliani (1961) argued that dividend policy should not play any role on determining the enterprise value in a long run. However, it is important to note that the idea of the model is not to dispute the fact that stock price is likely to drop on ex-dividend day. But since investors were considered to be irrelevant whether they receive returns as dividends or capital gains, the price drop should be similar regardless of the dividend policy (e.g., yield, payout ratio) of the company. Also, assuming investor irrelevancy between dividends and capital gains, there should not exist for example dividend-seeking investors at the market, whose existence would cause abnormal returns around ex-dividend day.

One study that agreed with the findings of Miller & Modigliani (1961) was the one made by Black & Scholes (1974). They examined whether dividend yields and stock returns are related to any extent and does the dividend yield have an effect on stock prices. The results were unambiguous, and there was no evidence found on relationship between dividend yields and stock returns. Their results indicated that dividend yield played no role in determining either long or short period returns. On the other hand, Elton & Gruber (1970) found evidence on dividend yield effecting stock prices on a really short term, according to them stock prices seem to drop on ex-dividend day more in case of stocks with higher dividend yield.

2.1.2 Bird-in-the-hand hypothesis

One argument that disagrees with findings of Miller & Modigliani (1961) is bird-in-the-hand hypothesis. Unlike Miller & Modigliani (1961) suggested, bird-in-the-hand hypothesis states that dividend payments have increasing effect on firm's value. This is due to uncertainty and riskiness of future cash flows. Since dividends are in that sense less risky than capital gains, companies should increase their dividend payout ratio if they want to maximise their value (Al-Malkawi, Rafferty & Pillai 2010). This notation has been confirmed by Barclay & Smith (1996) who concluded that due to more dangerous nature of capital gains investors seem to prefer dividends as a form of return. Because of lower risk in dividends, investors prefer "bird in the hand" over "two in the bush", which is why dividend paying companies end up

being valued higher than corresponding ones with no dividend payments. In market downturns, dividends received earlier are not affected and hence companies paying dividends can notionally be assumed to suffer less from negative shocks. If shareholders preferred higher dividends, it should basically mean the incidence of higher positive abnormal returns before ex-day and negative abnormal returns afterwards, especially in the case of high dividend paying companies.

Supporting results for bird-in-the-hand hypothesis has been found for example by Gordon (1959) who found that dividends had more influence on share price than retained earnings had. In his later research, Gordon (1963) stated that when companies increase the dividend payout ratio, it simultaneously has decreasing effect on cost of equity, which leads to increasing value of share price. Similar conclusion was made by Fisher (1961) and Walter (1963). In addition, Frankfurter & Wood (1997) state in their paper, that back in 1930s there existed some opinions that in general, the sole purpose of the company is to pay dividends, and dividend paying companies should always be valued higher than corresponding ones with no dividend payments. Gordon's (1959) approach to situation was already a bit more gentle, but he also claimed that investor rather buys a stock to get dividends than to get other earnings.

2.1.3 Signalling hypothesis

According to signalling hypothesis, dividends can be used as a channel of information and send signals to investors about company's future prospects. Unlike the model of Miller & Modigliani (1961), signalling hypothesis does not assume complete and precise information at the market. Baker & Powell (1999) state that with cash dividends companies can convey valuable information about management's assessment concerning the future profitability of a company to investors, which by other means is hard. Because of information asymmetry, management always has better knowledge on the state of the company than investors. Therefore, according to Baker & Powell (1999), managers can use dividends to reduce the gap in information asymmetry to signal private information to market. When investors receive better information, they may consider the company less risky and therefore this should have positive impact on company's stock price. If the gap on the information between

management and outsiders is too wide, the value of the company cannot be estimated accordingly at the market and share price does not reflect the actual value of the company (Al-Malkawi et al. 2010).

Like other theories, signalling hypothesis has few shortcomings as well. Al-Malkawi et al. (2010) note that there are two major requirements that need to be fulfilled before signalling hypothesis can hold. First, company needs to have an incentive to send the private information for investors. If they for instance consider the valuation of a company too low, they presumably have an intention to send information about better future prospects. On the other hand, if these expectations are poor, there is no reason to signal this to market as this would cause the stock price to drop. Secondly, the signal send to markets should be true and, in that sense, reflect the true state of the company. Koch & Shenoy (1999) note that in a case of poor future expectations companies should not send misleading signals to markets and increase dividends, since this could lead to false assumptions on company's future profitability.

2.1.4 Agency cost argument

Agency cost argument was first established by Jensen and Meckling (1976). This theory is built on the assumption that corporate managers and shareholders do not have similar interests, which causes agency costs. Since the interests differ, there is a risk that managers use company's funds to activities that are not profitable from the perspective of the shareholders. According to Al-Malkawi et al. (2010), excessive amount of funds on manager's hands may force shareholders to monitor managers and their actions more precisely, which naturally causes costs to shareholders. As Baker & Powell (1999) note, higher dividend payments reduce the amount of money managers have on use for these "useless" activities and therefore dividend payments are an efficient way to reduce agency costs. This forces companies to seek more actively sources for external financing, which in optimal case leads to increasing cash flows as additional cash flow requires selecting only profitable investments. Easterbrook (1984) went even further by stating that when dividends are paid, managers are forced to raise funds at capital markets. When operating at the market,

finance professionals like analysts and bankers also start monitoring the managers, which reduces the monitoring costs of shareholders.

Agency costs may occur also between bondholders and shareholders. In their examination, Jensen & Meckling (1976) state that conflict of interest between these groups arises when dividends are paid, since bondholders have funded the company with their money and when company is paying dividends, part of this money is being conveyed to shareholders. Therefore, bondholders usually use constraints on dividend payments when granting the loan for the company. In addition, bondholders do not benefit on increasing cash flows of the company like shareholders do. Since shareholders also have limited liability in case of bankruptcy and they often have decentralized portfolios, they are also willing to accept higher risk. For these reasons, shareholders should also prefer higher dividends. They do not see the point of having large amount of cash under the desk, but they rather want to benefit on profits instantly.

2.1.5 Clientele-effect

Previous three theories, bird-in-the-hand hypothesis, signalling hypothesis, and agency cost argument have suggested that paying higher dividends is beneficial for the company, since shareholders favor high dividends or in any case consider them as a good indicator about company's performance. The clientele-effect of dividends diverges from this view. The consequences of clientele-effect were noticed already by Miller & Modigliani (1961), who argued that when assumption of perfect markets is abandoned and transaction costs and taxes exist, investors tend to prefer such investments that minimize these costs. Because of individual preferences, different investors have different preferences concerning the dividend policy of a company for example. Miller & Modigliani (1961) state, that therefore each corporation "would tend to attract to itself a clientele consisting of those preferring its particular payout ratio". In terms of valuation, each of these clienteles should be equally good, which is why dividend policy should still remain irrelevant. By choosing a specified dividend policy, companies are able to attract certain type of "clienteles" as investors.

Since investors face different tax treatments, they prefer investing in such companies whose dividend policy matches their preferences. Because of taxes, investors are more interested on after-tax returns than gross returns, which is why different taxation in dividends and capital gains might influence on which is preferred. Investors in high tax brackets should therefore be attracted by low payout policy, while investors in low tax brackets prefer higher dividends. Also, investors who prefer steady and regular return on their investments should prefer high dividend paying companies. This is often the case with older generations. They do not have time or interest to wait the company's value to increase, and they rather have steady annual yield in a form of dividends, which also enables minimizing transaction costs associated with trading activities. (Baker & Powell 1999, Pettit 1977, Al-Malkawi et al. 2010). In a study of Pettit (1977), the evidence on positive relationship between the age of an investor and dividend yield of the portfolio was found. This confirms the assumption that older generations might prefer steady and regular cash flow, which provides them more money for consumption purposes annually. Also, Dhaliwal, Erickson and Trezevant (1999) concluded that dividend policy of a company has an impact to its owner base. Their study was conducted in United States, where capital gain taxation is more favourable for individual investors than dividend taxation. They noticed that the share of institutional ownership seems to significantly increase when companies initiate dividends, indicating that high tax bracket investors seem to reduce their ownership after the initiation.

Some papers, for example the one written by Brennan (1970) claim, that based on tax differences in dividends and capital gains, it would even be possible to develop a dividend optimization model that would maximize the market value of the company. The effect of taxation is particularly interesting in this paper, considering the research questions set in section 1.1. Taxation and its effects on ex-dividend day price drop will be observed more precisely later. At this point, it is enough that the notation about taxation and transaction costs related to dividend payments and capital gains is envisaged. These market imperfections may offer an explanation why some companies pay higher dividends than others, or in extreme case do not pay them at all.

2.2 Legislation on dividends

Since legislation is in most cases regulated on national level, there are some deviations in legislation between countries. Generally, shareholders have right to participate the decision-making process to some extent, since thanks to shares they own shareholders also have right to vote on corporate actions in Annual General Meeting (Hayes 2021a). However, this requires that shares they own are voting shares, which normally is the case (Hayes 2021b). For example, according to the Finnish Limited Liability Companies Act (624/2006), the decision on dividend payments is made in Annual General Meeting based on the proposal of the board of directors. The number of votes at the Annual General Meeting is based on the number of shares, so in the case of listed companies, the power of a private retail investor is very small. However, Finnish retail investors together own almost one-sixth of Finnish companies (Pörssisäätiö 2019). Thus, retail investors combined may have surprisingly lot of power.

From the investor's point of view, probably the most important legislative factor concerning dividends is their taxation. Like explained in previous section, taxation of dividends plays a key role in determining dividend policy, but also may to some extent explain the price behaviour of stocks on ex-dividend day, like suggested by Elton & Gruber (1970). Same conclusion has been made for example by Ainsworth, Fong, Gallagher & Partington (2016) in Australian markets. As shortly mentioned in section 2.1.5, the taxation legislation differs slightly depending on whether the dividend is paid to individual or a company. In this study, the focus is on listed companies, so exploring the legislation concerning private companies' dividend payments is irrelevant.

Since this study is conducted at Nordic markets, it is important to observe the differences in taxation of dividends in that region. In Finland, current legislation interprets dividend income as capital income. The general capital income tax rate is 30%. If the capital income of an individual exceeds 30 000 euros in a year, the tax rate for the amount exceeding the limit is 34%. The tax-free stake of the dividends paid by listed companies is 15%. Therefore, 85% of the dividends received from listed companies are counted as taxable income. In Denmark, the tax rate of dividends is 27% if the capital income does not exceed 56 500 Danish krone (DKK). Beyond this limit, the tax rate rises to 42%. Swedish legislation

differentiates significantly from the corresponding ones in Finland and Denmark. In Sweden, dividends are taxed at 30% rate despite the total amount of income. In other words, Sweden does not apply progressive taxation on dividend income like Finland and Denmark do. In figure 2, the taxation of an individual investor in different countries is presented, assuming that the dividend received has been paid by listed company and the investor is subject to lower tax rate of dividends in Finland and Denmark. (Finnish Tax Administration 2021a, Danish Tax Administration 2021a, Swedish Tax Administration 2021)

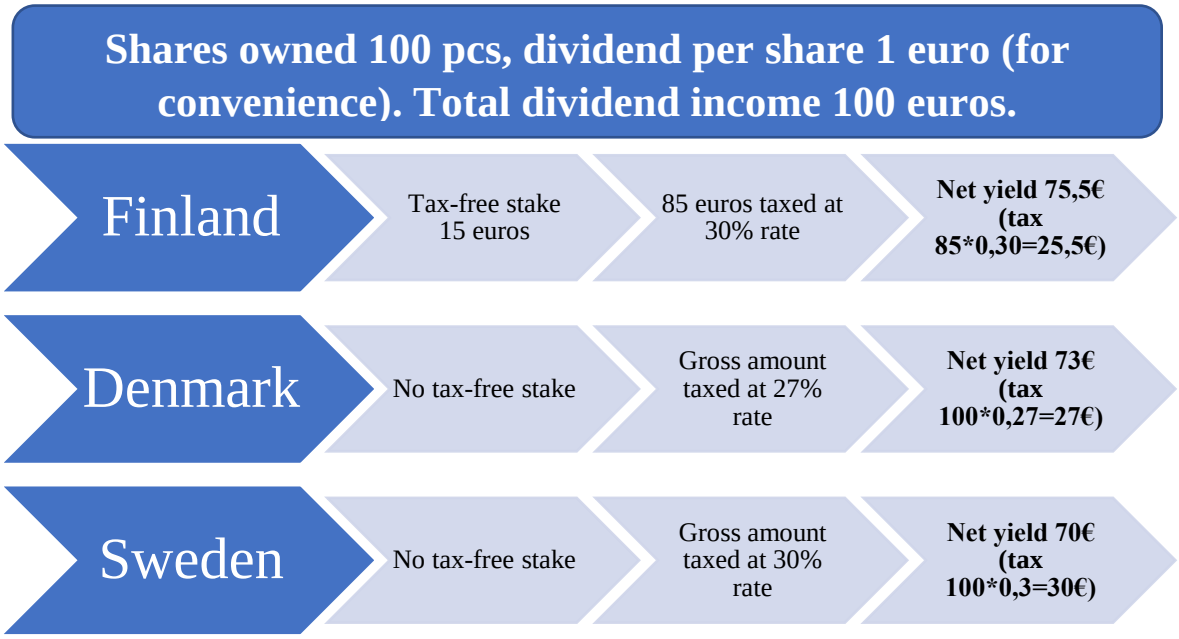

Figure 2: Example of dividend income taxation

Figure above shows, that for an individual receiving a small amount of dividend income, the taxation in Finland is the most favourable of the markets discussed in this paper with effective tax rate of 25,5%. This is the same rate that is charged as withholding tax on dividend income (Finnish Tax Administration 2021b). In fact, even though a Finnish investor was subject to higher tax rate, the taxation would still be more favourable than in Sweden thanks to the tax-free stake of 15%. With 34% rate, the marginal tax rate would be 28,9% (0,85*0,34=0,289). In Finnish markets the taxable income is lower than in Sweden or Denmark, which is why circumstances are more favourable in terms of dividend taxation. In Denmark, marginal tax rate rises remarkably if investor is subject to higher tax rate. In that case, marginal tax would be 42%, netting only 58 euros of dividends on the example

above. However, in such case the investor would have already had 56 500 DKK of dividends taxed at 27% rate, so the marginal rate is not perfectly comparable. In Sweden, the calculation is rather simple since despite the amount of dividends received the individual investor is always subject to 30% tax rate. Therefore, marginal tax rate remains constant and net yield is always 70% of the gross dividend income.

The legislation recognizes some exceptions concerning the taxation of individual dividend income. Probably the most noted one is the equity savings account, which enables tax-free trading and dividend income provided that the invested capital is not withdrawn from the account. The income will be taxed by the time the profits are transferred out from the equity savings account. The usage of equity savings account is limited, since countries assign the limitations concerning the maximum allowed amount of invested capital to accounts. Also, the number of accounts is also limited to one per individual. The equity savings account has been available in Finland since 2020, in Denmark since 2019 and in Sweden since 2012. (Finnish Tax Administration 2021c, Danske Bank 2019, Catella Bank 2021)

If the receiver of the dividend was institutional investor instead of individual, the tax treatment of dividends would be different. For example in Finland, if these dividends were received by public corporation, they would not have been taxed as dividend income at all and whole income would have been tax-free. Similarly, if the receiver of the dividend was a private corporation which owns more than 10% stake of the listed company, dividend income is tax free. Corporates pay their taxes based on their earnings, and dividends are not taxed separately. (Finnish Tax Administration 2021a). In Denmark, holding companies that own more than 10% of a listed company do not pay tax on dividends, but their earnings are taxed at 22% rate (Dania Accounting ApS 2021). The standard is similar in Sweden, resident corporations do not pay taxes on dividend income, but their earnings are taxed at 20,6% rate (PwC 2021). Like clientele-effect suggest, the differences in dividend taxation among shareholders may explain to some extent the stock price behaviour. In fact, Heikinheimo (2018) claims that in Finland institutional investors are more frequently on selling side around the ex-dividend day, since they do not benefit on the tax advantage of dividends compared to capital gains. This could in theory be one noticeable observation when evaluating the incidence of ex-dividend day anomaly and evaluating the factors which may explain the size of the price drop observed during dividend payments.

2.3 Background of the ex-dividend day anomaly

Paying dividends is the most common form for a company to distribute profits to its shareholders. Dividends can be paid in cash or shares, from which cash dividends are by far the most used form (Brav, Graham, Harvey & Michaely 2005). In Nordic markets, listed companies pay dividends on average once a year (Rantapuska 2008, Akhmedov & Jakob 2010). However, there are many companies who have a policy of not to pay dividends at all to their shareholders. Instead, they rather use their earnings for new investments for instance (Al-Malkawi et al. 2010). Other option to distribute profits to shareholders is share repurchase programme, which depending on taxation may in some markets be more favourable form from the view of shareholders. According to Skinner (2008) however, share repurchases can only be considered as temporary form of profit distribution, which is why companies should prefer dividend payments in the long run. Hedensted & Raballe (2008) investigated the profit-sharing methods of listed companies in Denmark, noticing that share repurchases are not used as a replacement for dividends, but companies committing repurchases also pay dividends.

From the investor's point of view, probably the most important date concerning the dividend payment is the ex-dividend day. That is because the investor is justified to receive dividend, if he or she owns the share of a company on the night before the ex-dividend day (Sijoitustieto 2019). In study language, this preceding day is called as a cum-dividend day (Korhonen 2014). Other key concepts related to dividend payments are record date and payment date. A dividend record date means the day on which the rights to the dividend, possible share issue and participation in the Annual General Meeting are determined based on confirmed list of shareholders. Instead, the dividend payment date is the day when dividend is paid to bank accounts of shareholders. (Sijoitustieto 2019)

Even though companies do not have any kind of obligation to pay dividends regularly, many investors value steady flow of dividends and wish to receive them annually (Lintner 1956). Dividends that remain stable from year to year are a significant source of income for many foundations for example, who have an intention to invest their assets with long-term strategy (Hämäläinen 2009). High and steady flow of dividends enables investors to plan their financials more efficiently in a long run, so investors who value steady cash flows and hence

prefer dividends usually select such stocks to their portfolio (Shefrin 2002, 30). For example, older generations may often prefer dividends over capital gains, since they are not willing to wait years for stock prices to increase.

Like stated at the introductory section, according to the traditional and common conception, the price drop of a stock on the ex-dividend day should be equal to the dividend paid out. However, the price drop may of course be affected slightly by the overall price increase or decrease at the market. In principle, it can be considered that the dividend to be paid out is included in the share price on cum-dividend day. When the dividend is detached, it is not included in the share price anymore and therefore, the price drop on ex-dividend day should equal with the amount of dividend.

Conceptions about equality between price drop and dividend are based on traditional dividend-based valuation model. For instance, Bali & Hite (1998) argued, that investors are not willing to pay more on dividends than its fair value, which is why in an equilibrium state the ex-dividend day price drop should equal the amount of dividend. According to the dividend-based valuation model, the value of the company can be counted by calculating the present value of future cash flows. An assumption here is that only the cash flows shareholders receive from the company are relevant when valuing a share. (Ikäheimo, Laitinen, Laitinen & Puttonen, 2014). In the case of shares, future cash flows are naturally represented by dividends. Therefore, the price drop on the ex-dividend day can be calculated based on the transformation of the present value of the share after the dividend has detached. If a shareholder intends to hold the stock for a one period of time, the price of a share can be counted like presented in formula 7 (Niskanen & Niskanen 2007, 127-128). The formulation matches with corresponding one introduced by Miller & Modigliani (1961), presented earlier in formula 2.

$$P_0 = \frac{D_1}{(1+r)} + \frac{P_1}{(1+r)} \tag{7}$$

If an investor wishes to hold the stock for two time periods, the formula can then be written as follows (Niskanen & Niskanen 2007, 128)

$$P_0 = \frac{D_1}{(1+r)} + \frac{D_2 + P_2}{(1+r)^2} \tag{8}$$

In this case, the market price of a share at time 2 (P_2) is formed as a sum of all future cash flows (year 3, year 4, year 5, …∞) discounted to present time. Thus, the valuation model can be written generally as a summation form in a following way.

$$P_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+r)^t} \tag{9}$$

Under the perfect market conditions described by Miller & Modigliani (1961), arbitrage opportunities would arise if the price drop did not match the amount of dividend paid. In a real world, transaction costs and taxes cause imperfection to the market and hence these arbitrage opportunities do not arise that frequently. The price of a share may drop more than the amount of dividend as well as less, depending on case-specific circumstances. According to Ankelo (2018), especially market overreactions, e.g., price drops of more than dividend, offer chances for traders to benefit from ex-dividend day price drop.

The ex-dividend day anomaly breaks the assumption that the price drop on ex-day should match with the amount of dividend. In fact, previous literature mainly indicates that the price drop is less than the dividend. From the most famous papers considering the topic, this conclusion was made for example by Campbell & Beranek (1955), Elton & Gruber (1970) and Kalay (1982). Since according to the empirical evidence the anomaly seems to exist at market, the assumptions and framework of EMH developed by Fama (1970) seem to be violated. If markets did reflect all available information and prices always adjusted accordingly, it would be impossible to gain excessive profits during market events, like dividend detachments. Market inefficiencies sometimes offer possibilities for abnormal earnings. Next, the theories created to explain the anomaly will be reviewed, each in a separate section.

2.3.1 Tax-effect hypothesis

The first steps of tax-effect hypothesis were taken in a study of Elton & Gruber (1970). When examining the magnitude of price drop on ex-dividend day, they provided a tax-related mathematical model to explain the stock price fluctuation on ex-day. Their study was partly built on framework of clientele-effect. Like Miller & Modigliani (1961) had already argued, in a world of taxes and transaction costs investors ambition is to minimize these costs to maximize the profit. Thus, differences in taxation of dividends and capital gains lead to situation in which the one with lower effective tax rate is preferred. This means, that if dividends are taxed with higher rate than capital gains, investors rather have their profit as capital gains and vice versa. Concerning this study, Finland is the only market area where taxation of dividends and capital gains differ, thanks to the 15% tax-free stake in dividends.

A key argument of the study of Elton & Gruber (1970) was that if dividends are taxed at higher rate than dividends, the ex-dividend day price drop should be less than the dividend paid. When an investor who is using long-term investment strategy has decided to sell the stock around the dividend detachment and aims to maximize the after-tax-wealth, he or she must make a decision between two options. Either sell the stock on cum-day with higher price or on ex-day with lower price but also receive a dividend. If the investor decides to sell the stock on cum-day, he receives the amount of money from the transaction corresponding with cum-day share price (P_c) and pays income tax on capital gains at rate (T_c), assuming that the cum-day price exceeds the purchasing price (P_a). On the other hand, if the investor decides to sell the share after the detachment of dividend, he receives the dividend (D) and from the transaction the amount of money corresponding to the share price on ex-day (P_{ex}). The investor needs to pay tax on dividend at rate of (T_{d}), and also income tax on capital gains at rate (T_{c}), if the selling price exceeds the purchasing price. If markets are efficient, it should not matter which of the options is chosen. Taking the taxes into account, the financial benefit should be equal in both cases. Therefore, according to Elton & Gruber (1970), the following equation must hold.

$$P_c - T_c * (P_c - P_a) = P_{ex} - T_c * (P_{ex} - P_a) + D * (1 - T_d) \qquad (10)$$

Rearranging the formula 10, the expected price drop ratio (PDR) on ex-dividend day can be counted based on differences in dividend and capital gains taxation:

$$PDR = \frac{P_c - P_{ex}}{D} = \frac{1 - T_d}{1 - T_c} \quad (11)$$

Therefore, Elton & Gruber (1970) argued that it is possible to count the expected price drop on ex-dividend day by comparing the effective tax rates between each other. The right side of the formula above confirms the statement presented earlier, that higher taxation of dividends compared to capital gains increases the ex-day price drop and vice versa.

The study of Elton & Gruber (1970) consisted of all dividend-paying companies listed in New York Stock Exchange between April 1966 and March 1967. They found the raw price drop ratio of the sample to be 77,7% and when taking into account the market movements 78,7%. Also, one extremely interesting finding was that there seemed to be positive correlation between dividend yield and price drop. Higher dividend yield seemed to indicate higher drop in a share price after the detachment of dividend. Elton & Gruber (1970) concluded that because taxation differences, investors preferred capital gains over dividends. Back then, dividends were treated as earned income in taxation in United States, which lead them to be less favourable in terms of taxation compared to capital gains.

It is possible to observe how changes in capital gain and dividend taxation should affect the price drop ratios on ex-dividend day according to the methodology developed by Elton & Gruber (1970), presented in formula 11. In this occasion, the focus is kept in regions that are under examination in this paper, so the observed countries are Finland, Denmark, and Sweden. Since legislation on dividend and capital gain taxation tends to change between the years, the same price drop ratio does not naturally apply throughout the investigation period. The following examples are constructed assuming that dividends are paid to individual investor, who belongs to lowest available tax bracket.

In table 1 below, it is presented how both capital gains and dividends are taxed between 2005 and 2019. These tax rates have been applied when an individual investor is concerned, and the information is gathered from websites of national tax administrations and OECD.Stat database.

Table 1: The development of dividend and capital gain taxation in Nordic countries from 2005 to 2019

	FINLAND		DENMARK		SWEDEN	
YEAR	Dividend tax	Capital gains tax	Dividend tax	Capital gains tax	Dividend tax	Capital gains tax
2005	28%, tax-free stake 43%	28%	28% / 43% (for gains over 43 300 DKK)	28% / 43% (for gains over 43 300 DKK)	30%	30%
2006	28%, tax-free stake 30%	28%	28% / 43% (for gains over 44 300 DKK)	28% / 43% (for gains over 44 300 DKK)	30%	30%
2007	28%, tax-free stake 30%	28%	28% / 43% (for gains over 45 500 DKK)	28% / 43% (for gains over 45 500 DKK)	30%	30%
2008	28%, tax-free stake 30%	28%	28% / 43% / 45% (for gains over 46 700 / 102 600 DKK)	28% / 43% / 45% (for gains over 46 700 / 102 600 DKK)	30%	30%
2009	28%, tax-free stake 30%	28%	28% / 43% / 45% (for gains over 48 300 / 106 600 DKK)	28% / 43% / 45% (for gains over 48 300 / 106 600 DKK)	30%	30%
2010	28%, tax-free stake 30%	28%	28% / 42% (for gains over 48 300 DKK)	28% / 42% (for gains over 48 300 DKK)	30%	30%
2011	28%, tax-free stake 30%	28%	28% / 42% (for gains over 48 300 DKK)	28% / 42% (for gains over 48 300 DKK)	30%	30%
2012	30% / 32% (for gains over 50 000 €), tax-free stake 30%	30% / 32% (for gains over 50 000€)	27% / 42% (for gains over 48 300 DKK)	27% / 42% (for gains over 48 300 DKK)	30%	30%
2013	30% / 32%, (for gains over 50 000 €), tax-free stake 30%	30% / 32% (for gains over 50 000€)	27% / 42% (for gains over 48 300 DKK)	27% / 42% (for gains over 48 300 DKK)	30%	30%
2014	30% / 32%, (for gains over 40 000 €), tax-free stake 15%	30% / 32% (for gains over 40 000€)	27% / 42% (for gains over 49 200 DKK)	27% / 42% (for gains over 49 200 DKK)	30%	30%
2015	30% / 33%, (for gains over 30 000 €), tax-free stake 15%	30% / 33% (for gains over 30 000€)	27% / 42% (for gains over 49 900 DKK)	27% / 42% (for gains over 49 900 DKK)	30%	30%
2016	30% / 34%, (for gains over 30 000 €) tax-free stake 15%	30% / 34% (for gains over 30 000€)	27% / 42% (for gains over 50 600 DKK)	27% / 42% (for gains over 50 600 DKK)	30%	30%
2017	30% / 34%, (for gains over 30 000 €) tax-free stake 15%	30% / 34% (for gains over 30 000€)	27% / 42% (for gains over 51 700 DKK)	27% / 42% (for gains over 51 700 DKK)	30%	30%
2018	30% / 34%, (for gains over 30 000 €) tax-free stake 15%	30% / 34% (for gains over 30 000€)	27% / 42% (for gains over 52 900 DKK)	27% / 42% (for gains over 52 900 DKK)	30%	30%
2019	30% / 34%, (for gains over 30 000 €) tax-free stake 15%	30% / 34% (for gains over 30 000€)	27% / 42% (for gains over 54 000 DKK)	27% / 42% (for gains over 54 000 DKK)	30%	30%

Counting the predicted price drop ratios based on differences in tax rates is very straightforward in Denmark and Sweden. Since in both countries dividends and capital gains are taxed with similar rates ($T_d = T_c$), the predicted PDR is always 1 (or 100%). The difference between these countries seems to be that in Denmark, the taxation is progressive while in Sweden it is flat. In Denmark, the earnings limit for lower taxation is adjusted annually (Akhmedov & Jakob 2010). Like table above indicates, this limit seems to have increasing trend in time, which sounds reasonable considering factors like inflation and general increase in income levels. However, if shares were purchased before 2006 and held over three years, the capital gain is tax-free in Denmark (Danish Tax Administration 2021b).

In Finland, the tax-free stake in dividends causes differences to effective tax rates on dividends and capital gains. In 2005, Finnish taxation system was reformed when corporate tax credit scheme was abandoned. In order to reconcile the old and the new system of taxation of dividend income, reduced tax rates were applied for 2005: the taxable share of dividends received by a natural person was 57%, even though the reformed law was in use from 2005. This was because dividends paid in 2005 were based on results of financial year 2004, which was under the old legislation. (Finnish Tax Administration 2005). Thanks to the large tax-free stake, the effective tax rate on dividends in 2005 is (1-0,43)*0,28=0,1596. By using the methods of Elton & Gruber (1970), the price drop ratio should be:

$$\frac{1 - 0{,}1596}{1 - 0{,}28} = 1{,}1672 \qquad (12)$$

From 2006, the tax-free stake of dividends was lowered to 30%. Thus, effective tax rate of dividends was 19,6 % ((1−0,3)*0,28 = 0,196). Price drop ratio from 2006 to 2011 should be:

$$\frac{1 - 0{,}196}{1 - 0{,}28} = 1{,}117 \qquad (13)$$

In 2012, the taxation of dividends and capital gains was transformed as progressive, like table 1 shows. In addition, the lowest tax rate was increased to 30%, instead of previous 28%. The effective tax rate of dividends from 2012 to 2013 was 21 % ((1−0,3)*0,3 = 0,21), and predicted price drop ratio:

$$\frac{1-0{,}21}{1-0{,}3} = 1{,}129 \qquad (14)$$

The latest change affecting the price drop ratio counted with methods of Elton & Gruber (1970) was made in 2014, when the tax-free stake on dividends was lowered to 15%. This means, that effective tax rate on dividends increased to 25,5% ((1-0,15)*0,3=0,255), and predicted price drop ratio in Finland starting from 2014 is:

$$\frac{1-0{,}255}{1-0{,}3} = 1{,}064 \qquad (15)$$

As the examples above prove, the changes in taxation should also affect the ex-dividend day price drops, if assumptions of Elton & Gruber (1970) hold. In this paper however, these changes and their effects can only be observed in Finland, since in Denmark and Sweden the taxation between dividends and capital gains does not differ. Like stated earlier, many previous studies have found the price drop ratio to be less than 1. However, most of them, including the one of Elton & Gruber (1970), has been made on American market, where taxation of capital gains is more favourable compared to dividends. Therefore, situation should be opposite in Finland.

2.3.2 Short-term trading hypothesis

Short-term trading hypothesis was first introduced by Kalay (1982). He posed some criticism towards the model of Elton & Gruber (1970), claiming that taxation could not explain the ex-dividend day anomaly alone. The key idea behind the short-term trading hypothesis is that an investor who faces similar tax rate for dividends and capital gains may acquire the stock on cum-day and sell on ex-day if the price drop on ex-day is less than the amount of dividend. This strategy is profitable, if the amount of dividend and tax benefit on unprofitable trade exceed the transaction costs. On the other hand, if the price drop was greater than the dividend, the investor could (short-) sell the stock on cum-day and buy it back on ex-day. In this case, strategy is profitable if, taking into account transaction costs and taxation, the share can be repurchased at less than the calculated value. These arguments

combined mean, that if either of them occurred, there would exist speculative arbitrage opportunities at the market. Based on these observations, Kalay (1982) constructed a mathematical model to count so-called no-profit opportunities condition like expressed in formula 16.

$$1 - \frac{\alpha P}{D} \leq \frac{P_c - P_{ex}}{D} \leq 1 + \frac{\alpha P}{D} \tag{16}$$

where $\alpha P = \text{Combined transaction costs of selling and repurchasing the share}$

By using the formula above, it is possible to estimate upper and lower boundaries for price drop, between which arbitrage opportunities do not exist. On the other hand, if the price drop lands beyond either of the boundaries, opportunities for free lunch open for short term traders. Therefore, thanks to these arbitrage-seeking short-term traders the price drop should always be between the boundaries since market forces compel it there to remove arbitrage opportunities.

Despite criticising and challenging the model of Elton & Gruber (1970), Kalay (1982) did not completely shoot down their explanation. Unlike Elton & Gruber (1970), Kalay (1982) interpreted the price drop to depend on both taxable factors and short-term traders. His opinion was, that both theories provided explanatory power on ex-dividend day price drop. Some of Kalay's (1982) findings were similar with corresponding ones of Elton & Gruber (1970). For example, Kalay (1982) concluded that as dividend yield increased, the price drop ratio increased as well, just like his colleagues stated about a decade earlier.

2.3.3 Price-discreetness hypothesis

According to the more recent literature, the ex-dividend day price drop may be affected by other factors besides taxes, even though short-term traders were absent from the market. The basic idea behind price-discreetness hypothesis is that a balanced outcome on the ex-dividend day price drop is equal with the amount of dividend rounded to the nearest tick. Tick size in stock exchange means the rounding practice in the value of shares, or in other words the smallest unit by which the price of a share may change (Kyynäräinen 2017). The

price-discreetness hypothesis is to some extent divided to few different “schools of thought”, which interpret the effect in a slightly different way. Theories related to price-discreetness have been developed for example by Dubrofsky (1992), Bali & Hite (1998) and Frank & Jagannathan (1998).

A study of Dubrofsky (1992) suggests that the price drop ratio on ex-dividend day should be less than 1. This is in line with conclusions of Elton & Gruber (1970) and Kalay (1982). However, Dubrofsky (1992) claims that bid-ask spread of a share should increase when moving from cum-day to ex-dividend day. Bid prices should fall more than offer prices on ex-day, causing the bid-ask spread to widen. He argued that this increase in spread offers explanatory power on ex-dividend day price drop. On the other hand, Bali & Hite (1998) offered different market-structure related view to explain the anomaly. They reported results that indicated the price drop of approximately equal to dividend and observed no changes in bid-ask spread. Bali & Hite (1998) presented a theory, that ex-dividend day price drop is equal with the amount of dividend rounded to next smaller tick, if the dividend is not divisible with tick size. They argued, that in such case the price drop cannot be rounded to next higher tick, since in that case purchasers were unwilling to make a trade and would rather delay it past the ex-day. The theory created by Bali & Hite (1998) is known as “tick size effect”.

Similar conclusion with Dubrofsky (1992) was achieved by Frank & Jagannathan (1998). Their study was conducted in Hong Kong stock market, where neither dividends nor capital gains are taxed. This allowed providing significantly different explanation for the anomaly compared to tax-effect hypothesis. The results indicated that price drop on ex-dividend day was half of the amount of dividend. Frank & Jagannathan (1998) argued, that this surprising result was related to bid-ask spread and discreetness or illiquidity it causes. According to authors, buyers preferred acquiring the stock on ex-day, while sellers preferred selling it on cum-day. This is because in a tax-free environment, it is a sort of burden for an individual investor to receive and collect the dividend, so they prefer capital gains over dividends. This effect leads to the outcome that on cum-day most of the trades are made based on bid price, while on ex-day most trades occur at ask price. Thus, price drop on ex-day is less than the amount of dividend since bid-ask spread exists at the market. This framework is known as “bid-ask spread effect”.

2.3.4 Tax heterogeneity argument

Tax heterogeneity argument, also known as dynamic trading clientele model, is closely related to tax effect hypothesis presented by Elton & Gruber (1970). Both theories suppose taxation as the key explanatory factor when price fluctuation on ex-dividend day is considered, but tax heterogeneity argument takes more precisely into account the clientele-effect. There are some other noticeable differences between these models as well and in some papers, tax heterogeneity has been considered as excellent factor in explaining the ex-dividend day price drop, which is why it should be looked over in its own section.

Tax heterogeneity argument was established by Michaely & Vila (1995). They argued that at the markets there exists investors who face different kind of taxation, and therefore employ different investment strategies and operating models, which can be used to explain the incidence of ex-dividend day anomaly. According to Michaely & Vila (1995), heterogeneity in taxation causes different types of sub-groups to exist at the market. An example of such are individual investors and institutional investors, who face different kind of tax treatment. Also, foreign investors may face different taxation than domestic investors, depending on the tax treaty between countries.

In their study, Michaely & Vila (1995) noticed that on average the price drop ratio on ex-dividend day should be approximately 1. On the other hand, when number of institutional investors participating in trading activities increased, the price drop was noticed to decrease. Michaely & Vila (1995) concluded that price drop on ex-day could be explained by using two variables. First one was the investors' average dividend and capital gain tax rates weighted by investors' risk tolerance, and second one was total risk in economy compared to the relative risk-bearing capacity. Together, these slightly complex variables should effectively explain the stock price formation on ex-day.

3. Previous literature on ex-dividend day anomaly

From the basis of results reported by Elton & Gruber (1970), several other authors started to examine the background of the anomaly. On a general level it seems, that previous literature has not achieved a consensus on which factors or which theory has the highest explanatory power on ex-day price formation. Some theories have been found to explain well the price movements on ex-day in one region, but simultaneously own no explanatory power in some other region. In this section, the findings of previous literature around the world and from Nordics are reviewed.

3.1 Worldwide evidence on ex-dividend day anomaly

Since the tax-effect hypothesis is the oldest theory created to explain the ex-dividend day anomaly, it is also widely studied and tested around the world. Results supporting the tax-effect hypothesis has been found for example by Poterba & Summers (1984) and later Stickel (1991). From the recent literature, Milonas, Tan, Tralvos & Xiao (2006) found supporting evidence on tax-effect hypothesis from Chinese market. In addition, Lasfer (1995) conducted an interesting study at British market. The taxation in UK was reformed in 1988, prior of which dividends were taxed with higher rates than capital gains. After reformation, the tax treatment became similar for both forms of income. The results of Lasfer (1995) support the assumptions of tax effect hypothesis. Prior to 1988, he documented positive returns on ex-dividend day share prices, meaning that the price drop ratio was below 1. This was the case especially with high dividend yield shares. After the reform, the price drop seemed to approximately match with the amount of dividend, just like suggested in tax effect hypothesis. However, Lasfer (1995) found that the effect of tax reformation was not as significant in stocks with low dividend yield. Also, he argued that structural factors like bid-ask spread had no impact on ex-day pricing, posing thus criticism towards the price-discreetness hypothesis.

Despite large amount of supportive evidence, some authors have also addressed criticism towards the tax-effect hypothesis. Like mentioned, one of the most significant critics has

been Kalay (1982), who argued that the price drop on ex-dividend day was not related to taxation only. For example, taxation is incapable to explain the positive relation between dividend yield and price drop ratio. Similar argument was presented by Eades, Hess & Kim (1984), who stated that there exists several factors which affect the price drop on ex-day alongside taxes, despite exclusively naming them however. Later studies, for example the ones of Boyd & Jagannathan (1994), Dasilas (2009) and Santos (2017) have found that factors like liquidity and market capitalization may also play a significant role in determining the ex-dividend day stock price.

Concerning the short-term trading hypothesis, the evidence has also been conflicting in later literature. For example, Lakonishok & Vermaelen (1983) investigated Canadian stock market and Booth & Johnston (1984) British market. In both papers, the price drop on ex-dividend day was observed being far from the amount of dividend, and hence the short-term trading hypothesis was refuted as the price drop did not lie between expected boundaries. On the other hand, in their later study, Lakonishok & Vermaelen (1986) found some supporting evidence on Kalay's (1982) theory by investigating the trading volume around the ex-dividend day. They noticed that the trading volume increased especially with high dividend yielding, actively traded stocks. In addition, they noticed abnormal increase in trading volume before ex-day, and correspondingly decreasing afterwards. This indicates that short-term traders exist at the markets during the dividend detachment. Lakonishok & Vermaelen (1986) concluded, that the price of companies paying a higher-than-average dividend yield increases before the ex-day because investors with a short-term trading strategy are especially looking for shares with high dividend yield. Similar finding about increasing trading volume was made by Kapichnikova, Munir & Teplova (2020) who focused their investigation on dividend aristocrats from 21 countries. Blau, Fuller & Van Ness (2011) noticed that short selling tends to increase on and after ex-dividend day, especially with high yielding stocks. This indicates that short sellers expect high yielding stocks to attract more investors, and therefore prices are expected to drop after the ex-day. Later, Boyd & Jagannathan (1994) found evidence that when observing the price fluctuation on ex-day, short-term trading hypothesis seemed to provide better explanation for high yielding stocks, but tax-effect hypothesis could explain better the price behaviour of stocks with low dividend yield. Similarly, Karpoff & Walking (1988) suggested that tax-effect

hypothesis and short-term trading hypothesis should be considered as complementary, not competitive theories.

In their study, Asimakopoulos & Hodgkinson (2001) found supportive evidence on price-discreetness hypothesis from British Market. They reported results comparable to Frank & Jagannathan (1988) and argued that price discreetness hypothesis offered better explanation for price fluctuation on ex-day than tax-effect hypothesis. Similarly, Al-Yahyaee, Pham & Walter (2007) found evidence that bid-ask spread effect was the supreme factor explaining the price formation on ex-dividend day in Middle East. Also, Mortal, Paudel & Silveri (2017) found evidence that structural factors at the market may explain the ex-day price behaviour. They reported statistically significantly different price drop ratios in NASDAQ and NYSE listed shares and offered structural factors as explanation, since they found no explanatory power on tax-related factors. On the other hand, Graham, Michaely & Roberts (2003) found the explanatory power of price-discreetness hypothesis to be very minimal in their study, and it alone cannot explain the price behaviour on ex-day. Jakob & Ma (2004) shared this opinion. Their major finding was that if price discreetness was eliminated at the market, the price drop on ex-day increased. Also, they reported that regardless of the tick size bid prices tend to drop more than offer prices on ex-day. This is highly conflicting with tick size effect and theory of Bali & Hite (1998), but to some extent similar with findings of Dubrofsky (1992). Based on later literature, the price discreetness hypothesis seems to divide authors really strongly whether it has explanatory power on ex-day price formation or not.

The last theory that was presented in previous chapter was tax heterogeneity argument. Since it is the newest theory created, it simultaneously is the least studied and tested as well. Also, tax heterogeneity argument is a bit more complicated than the others due to difficulty of risk tolerance measurement. However, for example Rantapuska (2008) argued that it seems to be obvious that around ex-day different types of investors exist at the market and seek profit opportunities by using the suitable strategies. Thus, tax heterogeneity argument should be focused on more in future literature. Dhaliwal & Li (2006) for instance found some supporting evidence for the tax heterogeneity argument. When observing US markets during tax regime changes in 1990s, they reported results that indicated relationship between ownership structure and trading volume around the ex-dividend day. Also, trading volume seemed to increase alongside the dividend yield. Zhang, Farrell & Brown (2008) investigated

the influence of tax cut, executed in United States in 2003, to ex-dividend day stock price behaviour. They found evidence that both risk levels and differences in dividend and capital gain taxation affect the ex-day pricing. Since the tax cut aligned the taxation of dividends and capital gains for individual investors, increasing PDR and weaking differences in clienteles were observed after the act. This was consistent with the tax heterogeneity argument. Since this argument is related to tax effects, basically papers that criticise tax-effect hypothesis provide conflicting evidence for tax heterogeneity argument as well. There is no universal consensus on how strongly taxation effects on ex-day price drop. Many papers support the argument that the effect is existent, but simultaneously the explanatory power of tax-related theories has been found to be minimal in several studies. All in all, it sounds reasonable to assume that several factors may affect on ex-dividend day price fluctuation and capturing them all to one model is extremely difficult, if not impossible.

3.2 Previous studies at Nordic market

Since ex-dividend day anomaly is widely examined subject around the world, previous literature includes also several papers made in Nordic markets. However, most of these papers focus on a specified country, and comparative studies in several countries in the region, like one made in Baltics by Neskova (2021), are harder to find. Studies at Finnish markets have been made for example by Sorjonen (1988) and Hietala (1990), who found taxation and tax-effect hypothesis to explain well the ex-dividend day price behaviour in Finland. For instance, Sorjonen (1988) noticed that the price drop ratio should be approximately 0,78-0,92, depending on the valid tax legislation. Hietala (1990) agreed with this one, reporting price drop ratios of 0,9 on average and arguing consistency with tax-effect explanation.

Some later studies indicate that ownership structure may also explain the incidence of ex-dividend day anomaly in Finland. Authors like Hietala & Keloharju (1995) and Liljeblom, Löflund & Hedvall (2001) report such results. For these papers it was common that foreign ownership seemed to reflect to some extent the ex-dividend day price formation. However, the impact direction is conflicting. Hietala & Keloharju (1995) argued that when foreign ownership increased, the price drop ratios increased as well. Their study was made on a

period of 1984-1990, when Finnish stock market was regulated considering the foreign ownership. The results indicated that in case of unrestricted shares, or in other words shares available for all investors, the price drop was higher than with the case of restricted shares. On the other hand, Liljeblom et al. (2001) argued that shares with high dividend yield and low foreign ownership seemed to drop more on ex-day than the ones with lower yield and high foreign ownership. However, these studies were made during different time periods and thus under different legislation. Also, it can be argued whether there were other factors, like liquidity, explaining the results between restricted and unrestricted shares. From the very recent literature, Rantapuska (2008) found signs of the impact of ownership structure, arguing that tax heterogeneity could explain the ex-day price behaviour in Finland. This however, was conflicting with findings of Sorjonen (1999), who found only weak support between 1989-1990, and no evidence on tax-clienteles between 1993-97 in his further research.

In Denmark, Akhmedov & Jakob (2005 & 2010) have made two prominent studies concerning the ex-dividend day anomaly. In both studies, they report relatively low price drop ratios, indicating that prices of shares drop in Denmark only 25 to 32 per cent on ex-day. The authors conclude that neither tax-related nor shot-term trading explanations are applicable in Danish markets since it would require higher price drops. Akhmedov & Jakob (2005 & 2010) reported results that support the assumptions of the model created by Dubrofsky (1992), stating that relatively illiquid markets combined with the shortage of limit order adjustment mechanism lead to low PDRs on ex-day. However, Akhmedov & Jakob (2005) note that for short-term traders, arbitrage opportunities could exist at the markets around the ex-dividend day.

In Sweden, the literature concerning the anomaly seems to be quite narrow. However, authors like Green & Rydqvist (1999) have tested same methodology at bond market, finding evidence there on tax-related explanations. Concerning equity markets, Daunfeldt (2002) investigated how marginal tax rates on dividends and capital gains influence the ex-dividend day price behaviour and trading volume around the ex-day. His sample included dividend payments between 1988 and 1995, when Swedish taxation system faced several changes and was therefore really attractive for investigation. Daunfeldt (2002) argued, that tax-related explanations could not solely explain the price fluctuation in Sweden, reporting significantly

lower price drop ratios as tax-effect hypothesis would suggest. He noted that higher dividend yield led to higher price drops on ex-day, despite there were no indicators on higher trading volume with these stocks. Daufeldt (2002) added, that investors might prefer capital gains over dividends also in circumstances where the effective tax rates are equal, because unlike dividends, capital gains are taxed on realization and not instantly. Later, Daunfeldt, Selander & Wikström (2006) reported results that indicated tax reforms to have significant effects on dividend payments, but not on price formation on ex-dividend day. When investigating stock market anomalies in Sweden on general level, Gao (2019) reported positive, highly significant abnormal returns on ex-dividend day.

4. Data and Methodology

As mentioned several times in earlier sections, this study focuses on Nordic stock markets. For this paper, three largest stock markets of Nasdaq OMX Nordic, which are OMX Helsinki, OMX Copenhagen and OMX Stockholm, were selected under examination. However, the sample has been limited to include only stocks that belong either to OMXH25, OMXC20 or OMXS30 index at given time. This limitation is made because majority of stocks included in these indices pay dividends frequently, which is a prerequisite for investigating the selected subject. In addition, these stocks are more actively traded and have on average better availability on necessary data than other stock listed at Nordic markets. The investigation period selected covers years from 2005 to 2019, meaning that market reaction on dividend detachments will be observed over a period of 15 years. Only cash dividends during the period are taken into account. In total, the sample consist of 1081 observations, dividing into three countries. The development of stock market indices during the investigation period is graphically presented below in figure 3. All data needed in this research is gathered from Thomson Reuters Eikon database.

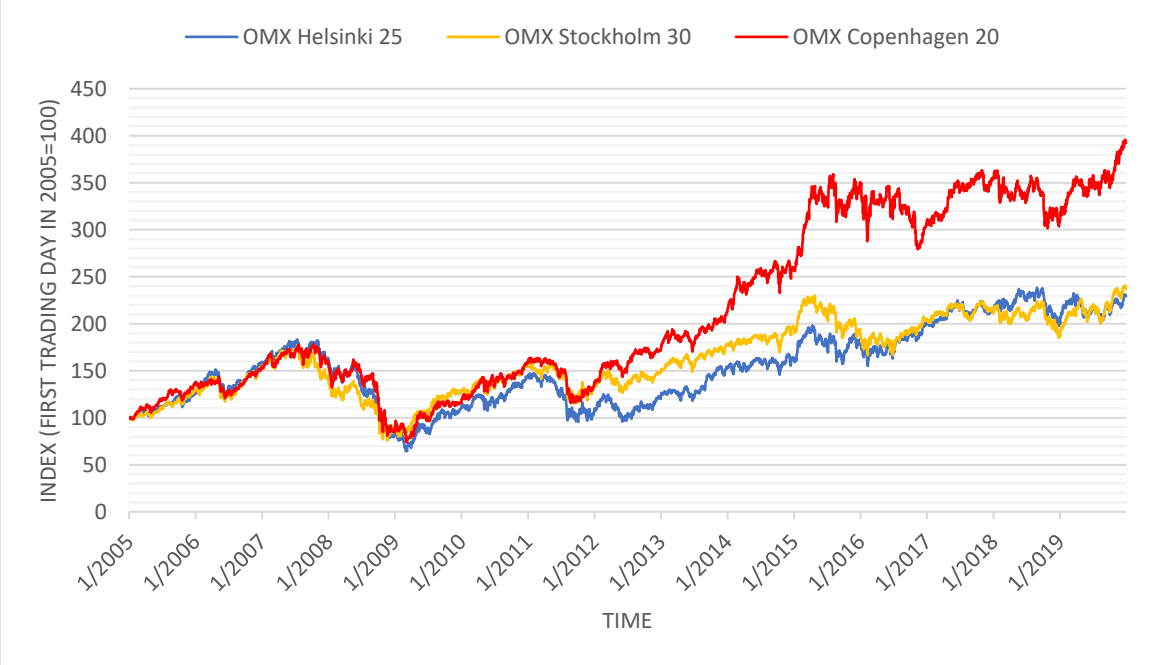

Figure 3: Development of Nordic stock market indices between 2005 and 2019

4.1 Variables

To successfully implement the research, several time-series variables are needed. First and foremost, ex-dividend dates, dividends, and daily quotations of each stock included in the analysis are required. In case of missing or ambiguous values in these variables, the dividend detachment in question is excluded from the analysis. Since the sample covers a 15-year period, conducted stock splits distort historical unadjusted dividend payments in case of splitted stocks. When determining the price drop ratios on ex-day, unadjusted dividends and daily closing prices are used. However, adjusted daily quotations are used when determining alpha and beta for each stock, in order to count possible abnormal returns around ex-dividend day. This is more precisely described in following sections. In some cases, the stock split has been implemented on same day as dividend is detached. In such situation, the ex-day price is multiplied with split factor, for example in 1:3 split with 3. If company has paid on same day ordinary dividend and special cash dividend, these payments are summed up and treated as one combined dividend payment.

When determining the factors affecting the price drop ratio and thus observed abnormal returns on ex-day, some other company-specific factors are also required. In this paper, these factors are dividend yield, market capitalization, P/E ratio, liquidity, volatility, retained earnings, market-to-book ratio, and turnover ratio on ex-dividend day. In several previous studies, including the ones of forefathers like Elton & Gruber (1970) and Kalay (1982), dividend yield has been noted significant when determining the PDR on ex-day. It is expected that in this study also dividend yield plays significant role in determining the ex-day price and higher yielding stocks face higher price drop. Similarly, for example Santos (2017) reported results that indicated positive relation between market capitalization and ex-day PDR. On the other hand, he reported negative relation between volatility and PDR as well as liquidity and PDR. P/E ratio and Market-to-book ratio, also known as P/B ratio, are common valuation measures used by investors, and their influence on the magnitude of ex-dividend day PDR should be investigated as well. According to the assumptions of short-term trading hypothesis, the trading volume should increase around ex-day, and possibly thus effect on ex-day price formation. Following Dupuis (2019), turnover ratio is used to measure the trading activity on ex-dividend day. Last, the effect of company´s dividend policy to ex-day price drop is tested. This done with retained earnings, which in this case

means the percentage of previous year's earnings per share that are not paid out as dividends in following year. As Miller & Modigliani (1961) presented, companies can choose between dividend payments and new investments when it makes profit. It is not obvious which one of these investors prefer, but because of its essential role in general profit distribution policy, retained earnings is included as explanatory factor to analysis. Company-level variables used in this analysis are presented in table 2.

Table 2: Variable descriptions

VARIABLE	DESCRIPTION
DIVIDEND	Amount of cash dividend per share at time t
EX-DAY PRICE	The closing price on first day after dividend detachment
CUM-DAY PRICE	The closing price of last day before dividend detachment
DIVIDEND YIELD	Dividend per share as a percentage of cum-day price at time t
MARKET CAPITALIZATION	Share price at time t multiplied by number of shares outstanding
P/E	Market price of a share (t) divided by earnings per share (t)
LIQUIDITY	Rate of transaction of a share, measured with bid-ask spread at time t
VOLATILITY	Degree of fluctuation at time t, measured with 5-year average annual historical fluctuation
RETAINED EARNINGS	Percentage of fiscal year earnings (t-1) not paid out as dividends
MARKET-TO-BOOK RATIO	Market value of the company (t) divided with book value (t)
TURNOVER RATIO	Trading volume of a share on ex-day divided by number of shares outstanding

Descriptive statistics of relevant variables are listed below in table 3. Variables called dividend, ex-day price and cum-day price are denoted in local currencies, being thus incomparable. Similarly, liquidity-variable is denoted as bid-ask spread in local currency. Market capitalization on the other hand is denoted in millions of units, again in local currency.

Table 3: Descriptive statistics

FINLAND	**n=377**										
	Dividend	Ex-day price	Cum-day price	DY	MC	P/E	Liquidity	Volatility	RE	MTB	TR
Mean	0,83	20,99	22,57	4,10%	8176,34	23,88	0,03	32,55%	31,36%	2,47	1,03%
St. Dev	0,57	13,67	15,22	0,02	10833	34,64	0,05	0,10	0,25	1,60	0,02
Median	0,70	18,35	19,06	3,80%	3343,87	16,60	0,02	30,33%	33,64%	1,98	0,62%
Min	0,05	2,39	2,67	0,09%	340,22	2,40	0,001	15,70%	0%	0,39	0,22%
Max	4,33	126,50	126,40	28,83%	75730,63	421,60	0,70	69,44%	94,82%	10,12	15,08%
Skewness	1,77	1,78	1,71	4,20	2,85	6,00	8,91	0,79	0,05	1,77	4,52
Kurtosis	6,67	8,91	6,61	42,08	11,12	57,60	116,49	0,12	-1,31	3,77	30,00
DENMARK	**n=240**										
	Dividend	Ex-day price	Cum-day price	DY	MC	P/E	Liquidity	Volatility	RE	MTB	TR
Mean	77,05	3370,87	3437,09	2,02%	86488,69	25,77	6,69	30,42%	53,70%	5,65	0,84%
St. Dev	277,34	11277,52	11460,65	0,04	124920,60	22,44	26,15	0,14	0,28	5,33	0,01
Median	5,97	350,25	360,90	1,51%	47140,11	21,95	0,40	26,60%	62,73%	3,82	0,36%
Min	0,19	48,10	48,65	0,21%	4694,56	4,40	0,05	14,82%	0%	0,58	0,001%
Max	1971	64000	65000	65,46%	743544,40	247	200	125,76%	97,92%	24,70	14,48%
Skewness	4,76	4,03	4,00	12,84	3,47	5,30	4,84	2,76	-0,75	1,63	5,80
Kurtosis	24,21	15,46	15,20	184,01	12,64	42,50	24,50	24,50	-0,58	2,18	52,94
SWEDEN	**n=464**										
	Dividend	Ex-day price	Cum-day price	DY	MC	P/E	Liquidity	Volatility	RE	MTB	TR
Mean	5,45	210,44	215,69	3,12%	142841,85	25,67	0,26	28,49%	40,19%	3,32	1,70%
St. Dev	3,69	174,27	175,13	0,018	156486,76	76,47	0,24	0,10	0,26	13,85	0,34
Median	4,50	159,25	164,75	2,85%	77677,38	16,50	0,20	25,93%	46,86%	2,57	0,72%
Min	0,25	12,05	12,35	0,37%	5185,30	2,50	0,01	16,07%	0%	-81,16	0,01%
Max	27,00	1305	1318	17,69%	1109060	1291,40	1,50	76,93%	93,88%	211,12	34,06%
Skewness	1,88	2,55	2,50	2,32	2,38	14,27	1,85	1,94	-0,33	9,58	5,90
Kurtosis	5,17	8,89	8,62	12,00	7,33	217,14	4,39	4,97	-1,04	145,78	44,25

Descriptive statistics in table 4 show that at Finnish market, the dividend yield seems to be highest on average. In fact, the average dividend yield in Finland is over double compared to Denmark. Based on this observation, the dividend-seeking investors should head to Finnish market rather than Swedish or Danish. Similarly, based on retained earnings, Finnish companies seem to be most generous in terms of dividend payout policy. From the point of view of valuation, the statistics are slightly unalike between countries. In terms of P/E ratio, all Nordic markets seem to be reasonably similar. However, when comparing market value to book value, Danish market seem to value listed companies highest, over twice higher than in Finland. An important notation concerning the P/E value is that due to its nature, raw data included several missing values. Those missing values have been replaced with closest available P/E value, for example one quarter backwards. Volatilities in different markets seem to be very similar, having though lowest values in Sweden and highest in Finland.

4.2 Price drop ratios

The core of this study is to examine the price drop ratios on ex-dividend day. This is done by using the methodology of Elton & Gruber (1970). Comparison of PDRs can be done for example between high yielding and low-yielding stocks, or between years. The mathematical expression of PDR calculation has previously been presented in formula 11, but it can be divided to two parts like expressed below in formulas 17 and 18. To avoid confusion, the "basic" price drop ratio is called as raw price drop ratio (RPDR) when documenting and analysing the results:

$$RPDR = \frac{P_c - P_{ex}}{D} \tag{17}$$

The formula above (17) is used when calculating the realized price drop on ex-dividend day. This value can be compared to expected PDR (or EPDR), calculated using the effective tax rates of dividends and capital gains.

$$EPDR = \frac{1 - T_d}{1 - T_c} \tag{18}$$

Since individual stocks are subject to market movements as well, this needs to be taken into account as well when observing the price drop ratios on ex-day. Similarly with numerous authors before, including for example Dasilas (2009) and Dupuis (2019), the so-called market adjusted price drop ratio (MDPR) is calculated as follows:

$$MPDR = \frac{P_c - [P_{ex}/(1 + R_{m(ex)})]}{P_c} \quad (19)$$

where $R_m = \text{Market return (Daily return of domestic index)}$

To take the analysis further, the similar kind of adjusted price drop ratio is used, but taking into account the sensitivity compared to market return and average historical excess return of a single stock. This can be done using betas and alphas, estimated using 250-day period before dividend payment. The estimation process is more precisely explained in section 4.3. When beta and alpha are taken into account, the beta-alpha adjusted price drop ratio (BAPDR) can be estimated with following formula:

$$BAPDR = \frac{P_c - [P_{ex}/(1 + (\alpha_i + \beta_i R_{m(ex)}))]}{P_c} \quad (20)$$

The statistical significance of all price drop ratios is observed by using Student's t-test, expressed in formula 21. The calculated t-value is compared to values in t-distribution table, after which the null hypothesis either stays valid or gets rejected.

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} \quad (21)$$

where

	$\bar{x}$	Sample average
	μ_0	The expected value according to null hypothesis (=1)
	s	Standard deviation
	n	Number of observations

When utilizing the Student´s t-test, the following hypotheses concerning the ex-dividend day price drops are set:

H0 = The price drop on ex-dividend day equals the amount of dividend paid

H1 = The price drop on ex-dividend day exceeds or undercuts the amount of dividend paid

When testing the statistical difference between two groups, for instance price drop ratios of high yielding and low-yielding stocks, the Welch t-test is used. The Welch t-test is an adaption of Student's t-test, but it allows variances of two groups to be unequal (Datanovia 2018). Similarly as Student's t-test, the null hypothesis in Welch t-test is equality in averages between observed groups, indexed with A & B in formula 22 below. The mathematical expression for calculation of Welch t-statistic is following:

$$t = \frac{\bar{x}_A - \bar{x}_B}{\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}}} \tag{22}$$

The examination of price drop ratios creates the backbone for this study. Next, methods used for further analysis are introduced.

4.3 Abnormal returns

Abnormal returns are being investigated by using event study methodology. The aim of event study is to investigate, whether the cross-sectional distributions of realized and expected returns significantly differ from each other. In other words, the average of realized returns inside event window should be zero, or more precisely should not statistically significantly differ from zero, to exclude the incidence of abnormal returns. (Kothari & Warner 2006, 10-11). Based on this statement, it can be concluded that possible abnormal returns in the sample can either be positive or negative. Hence, the hypotheses for the examination of abnormal returns can be written as follows:

H0 = The abnormal returns are zero

H1 = The abnormal returns are either positive or negative

To count abnormal returns, computational alphas and betas are used, which in this paper are estimated using 250-day period before dividend payment, like stated earlier in previous section. The event window is set to start from five days before the ex-dividend day and ending +5 days from the detachment of dividend. This means that event-window will be 11 days long, and ex-dividend day will be treated as day 0. When using event study, it is common that event window is somewhat longer than the principal date or period investigated in the study (MacKinlay 1997). The estimation window and event window should not overlap each other, so therefore the estimation window is between days -6 and -255 days from the ex-dividend day. Figure 4 illustrates the placement of the estimation and event window around the ex-day. Estimation of abnormal returns requires assessing the market return as well, which in this paper is made by setting the domestic All share-index as benchmark. This means, that in case of Finnish stocks, the market index is OMXHPI, for Danish stocks OMXCPI and for Swedish stocks OMXSPI.

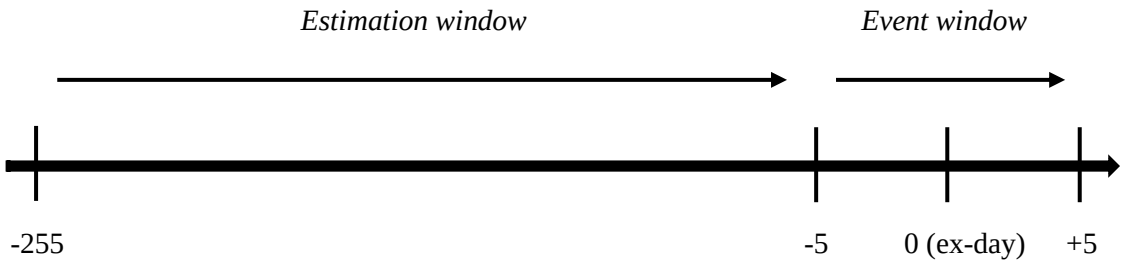

Figure 4: Estimation window and event window around ex-dividend day

To achieve accurate and reliable results, it is important to note that ex-dividend day should be treated differently than other days inside event window when estimating abnormal returns. On ex-dividend day, the amount of dividend needs to be taken into account and consider a price drop of equal to dividend per share as normal or expected return. Without this procedure, the outcome of the estimation would most likely be misleading negative abnormal returns on ex-dividend day. Also, ignoring the dividends on ex-day would turn the hypotheses set invalid, and they should be transformed since expectations on insignificant

abnormal returns would not be valid either. So as basic theory dictates, the expected return on ex-dividend day should be equal to dividend yield, but negative.

To estimate abnormal returns inside event window, the daily expected returns need to be estimated first. This is implemented according to formula 23.

$$R_{it} = \alpha_i + \beta_i R_{mt} \tag{23}$$

where $R_{it} =$ Expected daily return of stock i on day t

After this, daily abnormal returns can be calculated by deducting the expected return from realized return. Mathematically, this can be expressed in a following way:

$$AR_{it} = DR_{it} - R_{it} \tag{24}$$

where $AR_{it} =$ Daily abnormal return of stock i at time t

$DR_{it} =$ Realized daily return of stock i at time t

The formula above (24) represents the daily abnormal return for a single stock. In this study, the aim is to observe the average abnormal returns under each day inside even window. Hence, daily averages of abnormal returns, including all observations in the sample, need to be calculated by using formula 25. The statistical significance of the returns will be tested by using t-test, expressed in formula 21.

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it} \tag{25}$$

It is possible that inside event window the observed average abnormal returns may vary between days. For example, abnormal returns may act differently before the ex-day compared to period afterwards, for instance in such case where lot of investors with dividend capturing strategies exist at the market. Since some kind of variation most likely exists between days, it is reasonable to investigate cumulative abnormal returns inside event

window (Brooks 2014, 638). Cumulative abnormal returns (CAR) can be calculated using formula 26.

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{it} \tag{26}$$

where $(t_1, t_2) =$ Length of the event window

Cumulative abnormal returns are estimated as an average of the sample for each day inside event window, similarly as abnormal returns. The implementation is presented in formula 27. The outcome of this calculation is the cumulative average abnormal return (CAAR) inside the sample, including all observations. Observing CAAR enables more precisely to observe the development of abnormal returns before and after the dividend detachment, as well as under other short time periods.

$$CAAR(t_1, t_2) = \frac{1}{N} \sum_{i=1}^{N} CAR(t_1, t_2) \tag{27}$$

The statistical significance of cumulative abnormal returns is tested by calculating the test statistic J_1. Thus, similarly like in the case of AARs, cross-sectional test is used for testing the statistical significance of the reported results. Calculation of J_1 is presented in formula 28.

$$J_1 = \frac{CAR(t_1, t_2)}{\sqrt{\sigma^2(t_1, t_2)}} \sim N(0,1) \tag{28}$$

where $\sigma^2(t_1, t_2) = (t_2 - t_1 + 1)\sigma_t^2(t_1, t_2)$

4.4 Regression analysis

The examination of dependence between company-level explanatory variables and ex-dividend day price drop is done by using regression analysis. In this paper, ordinary least squares (OLS) method is used to fit the regression line to sample. OLS is known as classical linear regression model. According to Brooks (2014), a set of assumptions needs to be met in order to guarantee the OLS estimates to be BLUE (Best Linear Unbiased Estimates).

(i) $E(u_t) = 0$	Errors have zero mean
(ii) $Var(u_t) = \sigma^2$	Error term has a constant variance
(iii) $Cov(u_i,u_j)=0$	The error terms are uncorrelated with each other
(iv) $Cov(x_i,x_j)=0$	No perfect collinearity between explanatory variables
(v) $u_t \sim N(0, \sigma^2)$	The error term is normally distributed

If these assumptions are not met, the estimates of OLS may be biased. However, if the assumptions hold, OLS method can reliably be used, and it becomes the most efficient estimator for linear regression. All of these assumptions will be tested with statistical tests.

Since the research perspective in this paper is more like investor-orientated, the regression analysis will be run slightly differently than in many famous papers earlier. Unlike for instance Lakonishok and Vermaelen (1983), Boyd and Jagannathan (1994) and Bell and Jenkinson (2002), in this study the price drop ratio is not used as dependent variable in the regression to investigate factors influencing the price formulation on ex-day. Instead, similar approach as Dupuis (2019) is used to explain the ex-dividend day price fluctuation since it in theory meets the objectives of the study better. In his study, Dupuis (2019) used abnormal returns as explained variable instead of PDR. He noted, that in case of price drop on ex-dividend day equals with dividend paid, the abnormal return should be zero. This is because in such case, dividend yield and price drop should sort of exclude each other. Like explained in section 4.3., the normal return on ex-dividend day should be equal to dividend yield, but negative. Thus, when expecting a negative return equalling the dividend yield on ex-day, it

is possible to use observed abnormal returns as explained variable instead of price drop ratio when ex-day price formation is investigated. However, it is important to note that when using this methodology, the relations of explanatory variables to explained variable (AAR_i) are reverse compared to price drop ratio, which is more commonly used dependent variable in earlier literature. This is because if abnormal returns are positive, the price drop ratio is less than 1, or expressed in other words the price drop on ex-dividend is less than expected theoretical mean value. Naturally, same applies as reverse in case of negative abnormal returns.

The similar methodology with Dupuis (2019) has not previously been used in studies conducted at Nordic market, but it has earlier been used by Dasilas (2009) in Greece and Naranjo, Nimalendran & Ryngaert (2000) in United States, to mention a few. Therefore, by utilizing this methodology in regression it may be possible to find additional explanatory power and possibly novel results compared to earlier studies at the region. To some extent, this may also fill an existing research gap since this later approach has not been used for investigating the anomaly in Nordics. When including the external factors and firm characteristics whose impact to price drop on ex-day is supposed to be tested, the following regression equation, including error term, can be constructed:

$$AR_{0,i} = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} \ldots + \beta_8 X_{8i} + \varepsilon_i \quad (29)$$

where $\beta_0 =$ Intercept

$X_1 =$ Dividend yield (DY)

$X_2 =$ Market capitalization (MC)

$X_3 =$ P/E ratio

$X_4 =$ Liquidity

$X_5 =$ Volatility

$X_6 =$ Retained earnings (RE)

$X_7 =$ Market-to-book ratio (MTB)

$X_8 =$ Turnover ratio (TR)

When running the regression analysis, a diagnostics testing for the model needs to be implemented. Assumptions of normally distributed, homoscedastic, and no-autocorrelated residuals are tested with Shapiro-Wilk test, White's test and Durbin-Watson test, respectively. The results of these tests are reported alongside regression results. Concerning the normality assumption, Brooks (2014, 210) states that despite possible violations of normally distributed residuals, sticking with OLS method is desirable, if possible, since in large dataset the violation of normality is basically inconsequential. Heteroscedasticity and autocorrelation can be seen as more severe problems that need to be taken into account if existent. Concerning the White's test, p-values beneath the significance level of 0,05 indicate violation of homoscedasticity assumption forcing to use heteroscedasticity-consistent standard error estimates, also called as robust standard errors in the analysis (Brooks 2014, 186). The problem with autocorrelation is more likely existent in time series data than in cross-sectional regression like the one used in this study. However, the Durbin-Watson test is used to detect the possible first order autocorrelation. Test statistics close to 2 indicate no autocorrelation, which is a desirable outcome. Correspondingly, values close to 0 indicate positive and values close to 4 negative autocorrelation, respectively.

Multicollinearity is tested with variance inflation factor, i.e., VIF-test, by reporting the mean VIF-value of explanatory variables as a test statistic alongside regression results. The most common rule of thumb when evaluating the multicollinearity is that if VIF reaches values of over 10, operations like combining or excluding variables should be considered (O'Brien 2007). At this point, it seems that multicollinearity will not cause problems based on correlation matrixes of explanatory variables (see appendices 3-6). Virtually all values in matrices indicate relatively low correlation between variables, despite several variables being to some extent linked to stock valuation for example (see appendix 7).

5. Results

This section focuses on results observed from the sample using the methodology presented above. The section has been divided to three sub-sections, first of which consisting of price drop ratios and second one of abnormal returns. In last-sub section, the factors affecting the magnitude of ex-dividend day price drop and observed abnormal returns are aimed to be captured by implementing a regression analysis.

5.1 Price drop ratios

This section is intended to provide answer whether the ex-dividend day anomaly exists at Nordic stock exchanges and do price drop ratios between countries in the region differ. In addition, the fitness of methodology developed by Elton & Gruber (1970) is tested and price-drop ratios are observed under different sub-periods. Hence, a target is to provide answer to third sub-question set, and check if differences in dividend and capital gain taxation are capable to explain the ex-day price fluctuation.

In table 4, the observed price drop ratios are reported on a country level, as an average of all observations. The statistical significance is evaluated using a value of 1 as an expected price drop ratio, like theory suggests. Standard deviation is reported in parentheses under the average price drop ratios.

Table 4: Price drop ratios in different countries

FINLAND (n=377)			**DENMARK (n=240)**			**SWEDEN (n=464)**		
RPDR	MPDR	BAPDR	RPDR	MPDR	BAPDR	RPDR	MPDR	BAPDR
0,98 (0,67)	0,93** (0,54)	0,94** (0,55)	0,58*** (1,76)	0,63*** (1,51)	0,65*** (1,51)	0,94 (0,97)	0,93** (0,78)	0,92** (0,77)

Note: ***, **, * indicate significance at 1%, 5% and 10% levels, respectively

In general, it seems that price drop ratios in Nordic countries are below 1, indicating that prices drop on ex-dividend day with less than the amount of dividend. Thus, markets seem

to have characteristics of ex-dividend day anomaly. This observation is similar to several studies conducted earlier, including the ones of the forefathers like Campbell & Beranek (1955) and Elton & Gruber (1970), who also found the price drop ratio to be below 1.

On a country level, Finnish and Swedish markets seem to act quite similarly on ex-dividend day, while Denmark seems to deviate from this trend. In both Finland and Sweden, all counted price drop ratios seem to be higher than 0,9, meaning that they are fairly close to 1. In fact, raw price drop ratios in both countries differ statistically insignificantly from 1, meaning that the difference is insubstantial. However, both market adjusted price drop ratio and beta-alpha adjusted price drop ratios in Finland and Sweden seem to differ statistically significantly from 1 at 5% risk levels, having values of 0,93, 0,94, 0,93 and 0,92, respectively. Thus, both Finnish and Swedish markets seem to have anomalistic characteristics on ex-dividend day.

When comparing these finding to previous studies conducted in Finland at Sweden, some conflicting results can be obtained. Like stated earlier, Sorjonen (1988) claimed that the price drop ratio in Finland should be between 0,78 and 0,92. However, he noted that price drop on ex-day depends on valid tax legislation, and his study was conducted under different legislation than this one. In any case, price drop ratios obtained in this study do not fit inside the region reported by Sorjonen (1988). On the other hand, this study to some extent supports the findings of Rantapuska (2008), who concluded that price drop ratios should be reasonably close to 1 in Finland. However, his results showed price drop ratios slightly over 1, while in this study the ratios seem to be less than 1. Results from Swedish markets are contradictory with Daunfeldt (2002), who reported price drop ratios in his study, conducted for a period of 1988-1995, to be only 0,48 on average. Results in this paper indicate that price drop ratio in Swedish market is much closer to 1 than suggested by Daunfeldt (2002).

In Danish market, price drop ratios on ex-day seem to be well below 1, being thus also statistically significant from the anomalistic point of view, even at 1% risk levels. Low price drop ratios in Denmark were expected based on results of Akhmedov & Jakob (2005 & 2010), who reported price drop ratios of only 0,25-0,32 in their study. Clearly, the observed price drop ratios are not as low in this study but seem to be on average significantly lower

than theory would suggest, and also lower than corresponding ones in Finland and Sweden, indicating that ex-dividend day price behaviour seems to differ between Nordic countries.

Graham et al. (2003) note that when investigating price drop ratios, extreme values may affect the results excessively. To get rid of possible outlier problem, they use so-called trimmed sample excluding the upper and lower 2,5 percentiles of price drop ratios from the analysis. By trimming the sample, it is possible to lower the standard deviations also, which especially in Denmark seem to be relatively high compared to PDRs. Hence, concerning this study, the outlier problem would most likely exist at Danish market, where one extreme observation in PDR received a value of -16, meaning that price of a share increased from cum-day to ex-day 16 times compared to dividend, which had very low yield. Using the trimmed sample in this study, the results in different countries are following:

Table 5: Price drop ratios using trimmed sample

FINLAND (n=359)			DENMARK (n=228)			SWEDEN (n=442)		
RPDR	MPDR	BAPDR	RPDR	MPDR	BAPDR	RPDR	MPDR	BAPDR
0,99 (0,45)	0,95** (0,41)	0,96* (0,43)	0,69*** (1,02)	0,75*** (0,92)	0,77*** (0,97)	0,94** (0,62)	0,95** (0,57)	0,95** (0,56)

Note: ***, **, * indicate significance at 1%, 5% and 10% levels, respectively

Like expected, by using trimmed sample the standard deviations in all key figures drop significantly. However, in all cases this does not reflect as massive changes in PDR averages compared to untrimmed sample. Especially in Finland the changes are very minor. In Denmark however, the PDRs are now significantly higher, but still statistically significantly lower than 1 even with 1% risk levels. It is also noticeable that in Denmark the differences between differently counted PDRs are higher than in other two countries. For example, the difference between RPDR and BAPDR is 0,08 in Denmark, and BAPDR is over 1,1 times higher than RPDR. Since daily closing prices are used to count the PDRs in this study, it could be assumed that adjusted PDRs give more accurate results since they take into account market movements on ex-day unlike RPDR. Standard deviations are still highest in Denmark, indicating that variation in PDRs is highest there. However, Danish sample is the smallest as well, which may slightly affect to situation. In Sweden, all PDRs seem to be surprisingly equal, and basically the only noticeable change is that when using trimmed sample, the RPDR converts to statistically significant at 5% risk level.

One of the goals in this study was to test if tax legislation could be used to explain the ex-dividend day price formation. For this purpose, the methodology and hypotheses developed by Elton & Gruber (1970) are used. First, the focus is on Finnish market. If assumptions of Elton & Gruber (1970) hold, the price drop ratio in Finland should be above one, thanks to more favourable taxation in dividends than capital gains under current legislation. Using similar approach as Akhmedov & Jakob (2010), table 6 presents the results annually compared to EPDR calculated using the valid tax legislation at given time. Since the sample consists of only dividend paying companies in OMX25 index, the number of annual observations is relatively small. Due to small number of observations and small differences in Finnish PDRs between untrimmed and trimmed sample, the whole sample is used for this purpose in order to avoid the reduction of observations by trimming.

Table 6: Annual price drop ratios in Finland

Year	N	RPDR	MPDR	BAPDR	EPDR
2005	23	0,864	0,884	0,905	**1,167**
2006	25	0,893	0,773	0,812	**1,117**
2007	27	0,911	0,855	0,882	**1,117**
2008	25	1,176	1,04	1,019	**1,117**
2009	24	1,045	1,102	1,12	**1,117**
2010	25	0,976	1,012	1,032	**1,117**
2011	25	0,752	0,825	0,833	**1,117**
2012	24	1,037	0,934	0,962	**1,129**
2013	23	1,086	0,926	0,918	**1,129**
2014	22	1,063	1,011	1,021	**1,064**
2015	25	1,021	0,999	0,998	**1,064**
2016	24	1,079	0,984	1,001	**1,064**
2017	28	0,899	0,857	0,854	**1,064**
2018	26	1,014	0,963	0,971	**1,064**
2019	31	0,889	0,811	0,773	**1,064**

Based on the table above, it can be obtained that in most cases, the price drop ratio was below the expected one counted using the methodology of Elton & Gruber (1970). The expected price drop ratio was during every year above 1, but the observed ones were mainly below 1. Especially from 2005 to 2007, the EPDR seems to be highly incapable to predict the realized price drop ratio regardless of to which of the three observed ratios it is compared. During

some years, EPDR seems to be capable to predict the price drops at least reasonably well, for example in 2014, but despite couple of exceptions there seems not to exist undisputed evidence on its accuracy. For instance, in case of MPDR, EPDR suggests every year the price drop to be higher than the realized one. However, it is important to keep in mind that the sample is quite small annually, ranging from 22 to 31 observations, which may influence the results.

Table 6 above also shows, that despite minor or no changes in tax legislation, the PDRs seem to vary quite a lot between years. For instance, when observing the last five years in the sample, it can be noted that realized PDRs vary quite heavily almost every year, even though according to the framework of Elton & Gruber (1970), the price drop ratios should be equal between years during the period. This finding is conflicting with corresponding ones of Whitworth & Rao (2010), who found evidence that PDRs during different years were systematically related to dividend and capital gain tax rates. Even when observing the periods with similar legislation as a group of years, the expected and observed PDRs do not meet. During 2006-2011, the EPDR was 1,117, while averages of RPDR, MPDR and BAPDR on same period were actually all approximately 1, following thus the theoretical non-anomalistic pricing on ex-day. During 2014-2019 those values were 0,99, 0,94 and 0,94, respectively, while EPDR was 1,064.

In addition, it could be argued that the model of Elton & Gruber (1970) may not be the most suitable one in countries like Finland, where dividends are more favourable than capital gains in terms of taxation. Price drop ratios above 1 indicate that a company loses more its market value than basic theory suggests when it pays dividends. Generally, companies aim to maximise their market value, so if they constantly lose their value when paying dividends, they should not theoretically pay them. Keeping in mind that Finnish companies were the most generous ones in terms of dividend policy and yield in this sample, the outcome where part of their market value would regularly disappear sounds outlandish. Elton & Gruber (1970), as well as Whitworth & Rao (2010), conducted their studies in United States, where the individual taxation of capital gains is more favourable compared to dividends. Thus, the ex-dividend day price drop should be less than 1, contrarily to Finland. Based on the results obtained in this study, the tax-effect cannot effectively explain the ex-dividend day price formation in Finland.

A similar annual comparison as conducted in Finnish market is not as essential to be made in Sweden and Denmark, since in both these countries the difference between dividend and capital gain tax rates is constant, and in fact zero throughout the investigation period. Thus, the expected price drop ratio does not change between years. However, following Whitworth & Rao (2010), the sample can be divided to smaller sub-periods, which allows investigating the development of PDRs in time. The results of this act, using the trimmed sample, can be found in table 7.

Table 7: Periodical price drop ratios in Denmark and Sweden

	Denmark				Sweden			
Period	**N**	**RPDR**	**MPDR**	**BAPDR**	**N**	**RPDR**	**MPDR**	**BAPDR**
2005-2009	54	0,61** (1,18)	0,68** (0,91)	0,75** (0,89)	136	0,85*** (0,68)	0,91 (0,65)	0,89** (0,62)
2010-2014	64	0,70** (0,95)	0,70*** (0,88)	0,73** (0,92)	137	0,96 (0,48)	0,93* (0,46)	0,95 (0,46)
2015-2019	110	0,69*** (0,98)	0,81** (0,95)	0,80* (1,04)	169	1 (0,65)	0,98 (0,59)	0,99 (0,59)

Note: ***, **, * indicate significance at 1%, 5% and 10% levels, respectively

Results in table 7 are pretty much in line with what has been observed earlier. PDRs in Denmark seem to be statistically significant throughout the investigation period but having higher values during the latest years than during first third of the sample. In addition, the last five-year period seems to contain significantly more dividend payments in Denmark. Similar upward trend, but not as significant, can be observed from Sweden, as well as from Finland based on table 6. During latest years, many companies have started to pay their dividends in two parts, which to some extent explains this development. Despite that, the increase in Denmark is still noticeably high, and number of observations is over two times higher than corresponding one between 2005-2009. In Sweden, the development in PDRs seems also be upward sloping in time. During latest five-year period, all PDRs receive values of really close to one, being thus simultaneously statistically insignificant. The observation of upward sloping PDRs is interesting, and it cannot be explained with tax legislation since like stated earlier, EPDRs in both Denmark and Sweden are constant throughout the period.

Many prior studies, including the famous ones by Elton & Gruber (1970) and Kalay (1982), have found evidence that PDRs are to some extent affected by dividend yield. Generally, if

observed price drop ratios are found to be less than 1, they should anyway be closer to 1 as dividend yield increases. Next, it is observed whether this is the case in this study as well. The sample is divided to two parts according to the median of dividend yield. The investigation is conducted with both trimmed and untrimmed sample, as well as both country-specifically and on Nordic level, represented by row "All" in table 8 below. The absolute differences between high-yield and low-yield categories are counted and tested with Welch t-test. The statistically significant differences are bolded and marked with asterixis similarly as in earlier tables. Also, the statistical significance of the PDRs of both high yielding and low-yielding stocks are tested separately.

Table 8: Price drop ratios for high and low dividend yield shares

Untrimmed sample										
		High yield (>M_d)			**Difference**			Low yield (<M_d)		
	M_d (%)	RPDR	MPDR	BAPRD	RPDR	MPDR	BAPRD	RPDR	MPDR	BAPRD
FIN	3,798	1,02 (0,36)	1 (0,36)	1 (0,37)	0,08	**0,14****	**0,13****	0,94 (0,86)	0,86 (0,67)	0,87 (0,67)
DEN	2,016	0,83*** (0,63)	0,85*** (0,61)	0,84*** (0,58)	**0,50****	**0,44****	**0,38****	0,33*** (2,39)	0,41*** (2,04)	0,46*** (2,04)
SWE	3,122	1,05 (0,57)	1,04 (0,45)	0,97 (0,44)	**0,23****	**0,22*****	**0,18*****	0,83** (1,24)	0,82*** (1,0)	0,79*** (0,98)
ALL	2,857	1,02 (0,52)	1 (0,41)	1,01 (0,41)	**0,29*****	**0,28*****	**0,29*****	0,73*** (1,50)	0,72*** (1,25)	0,72*** (1,25)
Trimmed sample										
		High yield (>M_d)			**Difference**			Low yield (<M_d)		
	M_d (%)	RPDR	MPDR	BAPRD	RPDR	MPDR	BAPRD	RPDR	MPDR	BAPRD
FIN	3,904	1,04 (0,34)	1,02 (0,31)	1,02 (0,32)	**0,09***	**0,13*****	**0,13*****	0,95 (0,54)	0,89*** (0,49)	0,89*** (0,51)
DEN	1,545	0,80*** (0,60)	0,82*** (0,56)	0,82*** (0,54)	0,22	0,15	0,10	0,58*** (1,30)	0,67*** (1,17)	0,72** (1,26)
SWE	2,923	1,01 (0,44)	1,01 (0,34)	1,01 (0,33)	**0,14****	**0,13****	**0,13****	0,87** (0,74)	0,88** (0,73)	0,88** (0,72)
ALL	2,929	1,01 (0,41)	1 (0,34)	1 (0,34)	**0,21*****	**0,19*****	**0,18*****	0,8*** (0,88)	0,81*** (0,81)	0,82*** (0,84)

Note: ***, **, * indicate significance at 1%, 5% and 10% levels, respectively

Based on the table above, the assumption about higher price drop ratios in higher yielding stocks seems to hold. In both trimmed and untrimmed sample, the differences in PDRs between the yield groups seems to be in most cases statistically significant. The only exception is Denmark in a trimmed sample, where differences in RPDR, MPDR and BAPDR receive p-values of 0,22, 0,15 and 0,10, respectively, being thus statistically insignificant.

However, the absolute differences seem to be noticeable in this case also, but due to reasonably high variation especially in low-yielding stocks the difference is insignificant. Finnish and Swedish samples support the assumption of higher PDRs in higher yielding stocks, showing statistically significant results in almost all cases. The only exception is RPDR in Finnish untrimmed sample, where the absolute difference of 0,08 received a p-value of 0,26, being thus statistically insignificant.

Country-level comparison shows similar evidence in both high-yield and low-yield stocks as observed earlier. In Denmark, the PDRs seem to be clearly lowest in both sub-samples. From the investor's point of view, this means that Danish market may open better possibilities for excess returns on ex-day compared to Finland and Sweden. Similar observation has been made by Akhmedov & Jakob (2005). For example, if the price drop on ex-day is 80% of the amount of dividend, an investor holding the stock over the ex-day receives the dividend, and simultaneously benefits from the low price drop ratio on ex-day, since the stock price drops less than the dividend detachment indicates. If a company is valued at 100 DKK on cum-day and it pays a dividend of 1 DKK on ex-day, with a price drop ratio of 0,8 the investor would have 100,20 DKK worth of assets at the end of ex-day. This is because the investor has received the 1 DKK dividend, and the market value of the share has dropped to 99,2 DKK. However, including all possible ancillary costs, the excess return may be lower in a real world. Basically, a PDR of 0,8 would open a possibility for excess returns with the stake of 20% of the amount of dividend.

Table 8 also shows, that excluding Denmark, the anomalistic PDRs are observed only in low-yielding stocks. PDRs in high-yield category never deviate from 1 even with 10% risk levels, meaning that price drop ratios violating the theoretical assumption of equal dividend and PDR can be found from low-yielding stocks. This may be explained with investor's desire for higher dividends. If the demand for high dividends increases before ex-day, it pushes the stock prices higher. After the detachment, investors are ready sell their shares, which instead gives downward pressure for stock prices. The outcome is that the PDR turns out to be higher on ex-day. In addition, it can be observed that PDRs of higher than 1 on average are never statistically significant, meaning there is no evidence on prices dropping with more than the amount of dividend on ex-day. This matches with the assumption that in

the long run, PDRs over 1 would probably influence the desire of companies to pay dividends since part of their market value would in such case sort of disappear.

When observing Nordic market as a whole, it seems to hold that PDRs increase as dividend yield increases. PDRs in entire sample show highly significant differences between high-yield and low-yield stocks. However, when using the combined sample, the majority of shares in low-yield category are Danish where the dividend yield seems to in general be the lowest, so in principle some country-level characteristics could also explain the difference. Despite that, based on the results reported in table 8 there seems to be clear evidence that price drop on ex-day is positively related to dividend yield. This is in line with previous observations in Nordic markets, for instance with Liljeblom et al. (2001) and Daunfeldt (2002), to name a few.

5.2 Abnormal returns around ex-dividend day

Earlier literature recognizes evidence that abnormal stock returns exist around the ex-dividend day. For example, Henry & Koski (2017) reported 0,17% positive abnormal return on average on ex-dividend day in their study. It could be argued that the existence of abnormal returns is typical in anomalistic circumstances since market behaviour seems to deviate from what theory dictates. The existence of abnormal returns has been explained with short-term traders, who seek arbitrage profits by trading few days before and after the dividend detachment, and not only on cum- and ex-day (Allen & Michaely 2003, 42). Hence, the investigation of abnormal returns should be done for a longer period than only for ex-dividend day.

Eades et al. (1984) observed in their study, conducted in United States, that the abnormal returns were mainly positive until the ex-day, after which they turned negative. This was explained with the behaviour of dividend-seeking investors, who start acquiring shares few days before the dividend detachment and sell their holdings after the ex-day. Similar observations have been made elsewhere as well, for example by Kadapakkam, Meisami & Shi (2010) in Hong Kong and Rantapuska (2008) in Finland. Dasilas (2009) investigated the ex-dividend day anomaly in Greece and reported abnormal returns around the ex-day as well.

He used wider event window than the corresponding one in this study, investigating the abnormal returns 20 days before and after the dividend detachment. The greatest abnormal returns were observed on ex-day, being significantly positive. He also observed statistically significant positive returns for a couple of days prior the dividend detachment as well, indicating that dividends possibly attract at least certain type of investors. After the ex-day the returns were more likely negative, similarly as observed by Eades et al. (1984) and Rantapuska (2008).

The average abnormal returns observed in this study are reported below in table 9. Like stated earlier in section 4.3, the event window used in this study covers 11-day period from -5 to +5 days from the dividend detachment. The abnormal returns are reported as daily average for all days inside event window.

Table 9: Average abnormal returns

	Finland		Denmark		Sweden	
Day	**AAR (%)**	**t-value**	**AAR (%)**	**t-value**	**AAR (%)**	**t-value**
-5	0,121	1,35	-0,242**	-2,11	0,063	0,70
-4	0,042	0,46	0,083	0,72	0,062	0,69
-3	0,184**	2,04	0,149	1,30	0,059	0,65
-2	0,172*	1,92	0,115	1,00	0,079	0,88
-1	0,174*	1,93	0,193*	1,69	-0,139	-1,55
0	0,097	1,08	0,393***	3,44	0,121	1,34
1	-0,153	-1,70	0,064	0,56	0,085	0,95
2	-0,014	-0,15	0,161	1,41	-0,007	-0,07
3	-0,027	-0,30	0,032	0,28	0,085	0,95
4	0,048	0,53	0,101	0,88	0,046	0,51
5	-0,128	-1,43	0,095	0,83	-0,091	-1,01

Note: ***, **, * indicate significance at 1%, 5% and 10% levels, respectively

Based on table 9 above, some interesting differences in abnormal returns between countries can be observed. Finnish market seems to follow the pattern that before the ex-dividend day abnormal returns appear positive and turn negative afterwards. Thus, it could be expected that dividend-seeking investors exist at the market, and investors wish to receive their earnings as dividends. This is in line with what has been observed before. As stated, Finnish companies seemed to be the most genuine ones to pay dividends, at least when comparing

the dividend yield and retained earnings. Also, Finnish investors can be expected to prefer dividends over capital gains thanks to more favourable taxation, which could boost the demand of shares before the ex-day. In addition, dividends do not include transaction costs, unlike the realization of capital gains. However, despite being mostly positive before and negative after the ex-dividend day, the observed abnormal returns are in most cases statistically insignificant. The only significant returns are observed between days -3 and -1. Dasilas (2009) reported that highest abnormal returns were be observed on ex-day. In this occasion this does not hold since abnormal returns seem to be higher before than on ex-day. In addition, the observed average abnormal returns on ex-day are only approximately half of what was reported by Henry & Koski (2017). Low abnormal returns on ex-day were to some extent expected in Finland, since like observed earlier, the price drop ratios in the region were also reasonably close to 1, leaving thus only a little room for abnormal returns. Also, Liljeblom et al. (2001) reported higher abnormal returns in Finland during ex-day with an average of 0,23%. However, their study was conducted at different time period and reported lower price drop ratios than this study.

In Denmark, the average abnormal returns seem to be positive throughout the event window, excluding the day -5. There is a clear difference to Finland for example, since Danish returns seem not to turn negative after ex-day. The abnormal returns are significantly positive before the dividend detachment only on day -1, thus giving some support to the hypothesis of dividend-seeking investors. However, the lack of negative abnormal returns after the ex-day indicates that excessive sales do not appear right after the dividend detachment. Similarly as observed by Dasilas (2009), the abnormal returns seem to have their highest values on ex-day, being highly significant. Positive abnormal returns on ex-day were sort of expected in Denmark since the price drop was observed to be relatively low in a previous section.

Swedish market also seems to have some characteristics that are not observed in Finland or Denmark. Throughout the event window, the abnormal returns observed in Sweden are quite low, and hence also statistically insignificant during all days. There is no similar pattern to be observed as in Finland, since the abnormal returns do not have exclusively positive or negative values before and after the ex-day. This may be explained with the different behaviour of investors compared to Finland. In Sweden, both dividends and capital gains are taxed at same rate, so in theory investors should be indifferent whether they receive the

return as dividends or capital gains. Negative abnormal return, though statistically insignificant, on cum-day is conflicting with assumption that dividend-seeking investors would exist at the market. Highest positive abnormal return, but once again statistically insignificant is observed on ex-day with a value of 0,121%. This is pretty much in line with what could be expected based on Swedish PDRs.

All in all, stock markets in different Nordic countries seem to act slightly differently around the ex-dividend day. Figure 5 compares the observed abnormal returns between countries and presents them in a graphical form. It is easy to obtain the different trend in abnormal returns between countries, especially right around the ex-day.

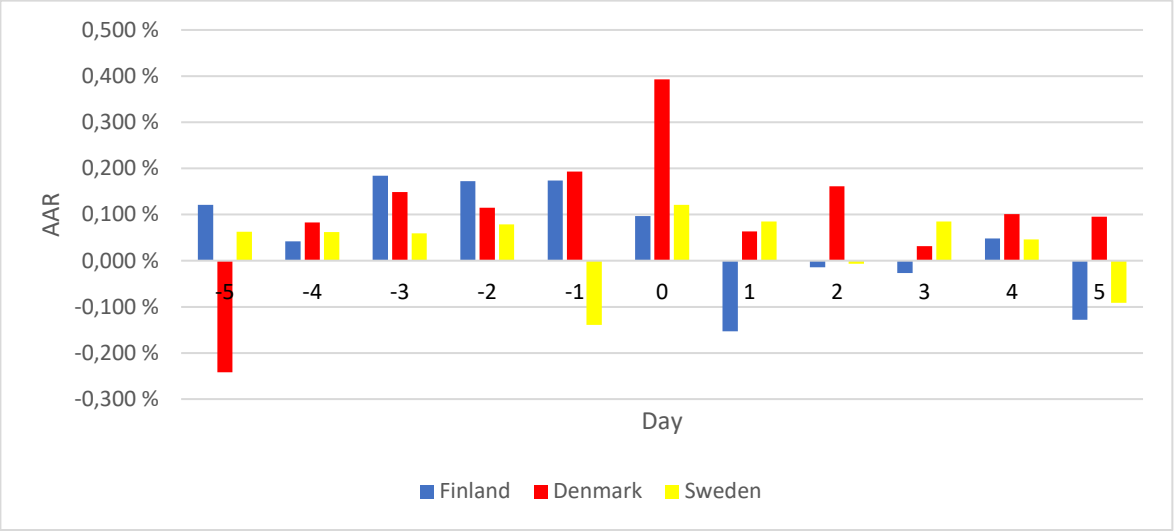

Figure 5: Abnormal returns in different countries

The observation of cumulative average abnormal returns gives insight of how significantly abnormally high or low returns accrue around ex-dividend day. The development of cumulative abnormal returns is linked to average abnormal returns, and thus should have similar characteristics. For example, Dasilas (2009) reported that cumulative average abnormal returns should be significantly positive before the ex-dividend day but turn down afterwards. Using similar event window as in this study, Eades et al. (1984) reported 0,33% cumulative abnormal return between days -5 and +5. In Nordics, Liljeblom et al. (2001) investigated accruing abnormal returns at Finnish market, reporting statistically insignificant positive returns during the same time period. However, their results indicated that

cumulative abnormal returns are statistically significantly positive on a shorter period, from day -1 to +1.

The cumulative average abnormal returns observed in this study are reported in table 10. The investigation is conducted using six different sub-periods inside event window.

Table 10: Cumulative average abnormal returns

	Finland		Denmark		Sweden	
Time	**CAAR (%)**	**J_1**	**CAAR (%)**	**J_1**	**CAAR (%)**	**J_1**
(-5…-1)	0,693***	3,45	0,297	1,16	0,123	0,61
(-1…0)	0,271**	2,13	0,586***	3,63	-0,018	-0,15
(-1…1)	0,118	0,76	0,650***	3,29	0,067	0,43
(0…5)	-0,177	-0,80	0,845***	3,02	0,238	1,08
(1…5)	-0,274*	-1,37	0,452**	1,77	0,118	0,59
(-5…5)	0,516**	1,73	1,142***	3,01	0,362	1,22

Note: ***, **, * indicate significance at 1%, 5% and 10% levels, respectively

Like average abnormal returns, also cumulative ones indicate noticeable differences between countries. Starting in Finland, the highest cumulative returns seem to occur before the ex-dividend day, where a five-day period offered almost 0,7% excess yield. The returns were positive and statistically significant until the ex-dividend day, after which they started to drop. This observation is similar with Dasilas (2009), for example. During the periods starting after the dividend detachment, the observed returns were negative but not highly significant. Despite the decreasing trend after the ex-day, the 11-day period provided approximately 0,5% excess yield, being simultaneously highly significant. This is higher yield than the corresponding one observed by Eades et al. (1984). Similarly, Liljeblom et al. (2001) argued that cumulative abnormal returns during the particular period were positive, but statistically insignificant at Finnish market. Also, they reported statistically significant results from day -1 to day +1, which was not the case in this study. Taken as a whole, Finnish market seems to offer the highest abnormal returns before the dividend detachment, but after the ex-dividend day this trend seems to turn negative.

In Denmark, the cumulative abnormal returns seem to be positive throughout the event window and in most cases statistically significant. The entire 11-day period seems to provide

1,14% excess yield on average, which is over three times higher than what was reported by Eades et al. (1984). However, the cumulative abnormal return before the ex-dividend day is lower compared to Finland for example, or to results of Dasilas (2009), who reported 1,4% cumulative abnormal return in his study between days -5 and -1. It seems that high cumulative yields in Denmark can be explained with significantly high abnormal return on ex-day, and with continuing increasing trend after the dividend detachment. There is a massive difference to Finland for instance when looking the cumulative abnormal returns during a period from ex-day to day +5. These high cumulative returns may open possibilities for arbitrage-like profits in Denmark around ex-day, just like argued by Akhmedov & Jakob (2005).

The Swedish market on the other hand does not seem to provide statistically significant cumulative yield around the ex-dividend day. The returns seem to be slightly positive during almost all time periods, but there is no evidence on abnormally high or low returns. The 11-day period around ex-day seems to provide 0,36% cumulative abnormal yield on average, which is comparable with what was reported by Eades et al. (1984). However, clear sings of increasing returns before or decreasing returns after the ex-day cannot be observed. Hence, the results from Swedish market deviate from corresponding ones obtained in Finland. Also, comparing to results of Liljeblom et al. (2001) evidence on statistically significant returns between days -1 and +1 was not found, and yield at the particular time seems to be really low. To visualize the differences better between Nordic countries, the cumulative abnormal returns detected inside the event window are graphically presented in figure 6.

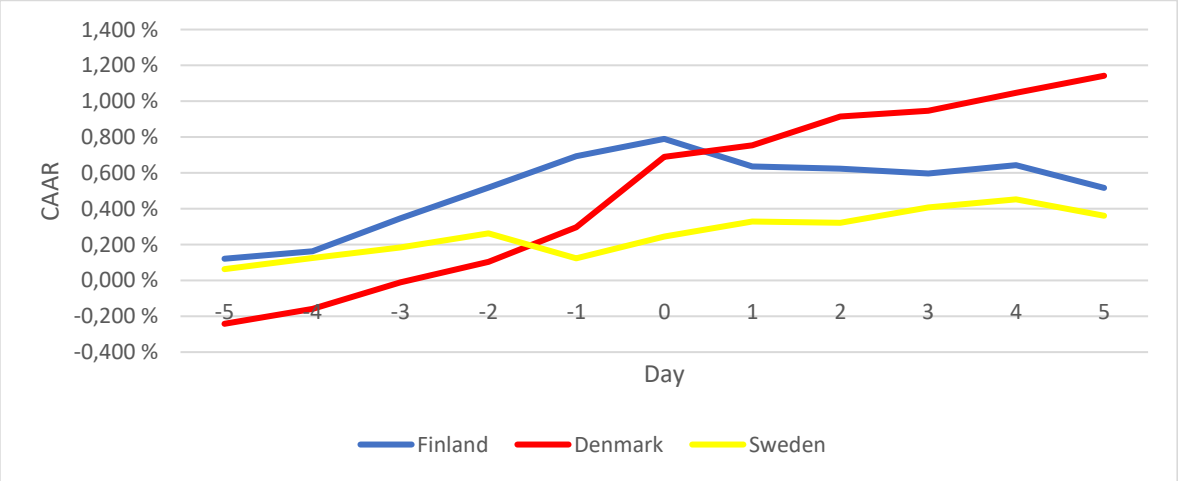

Figure 6: Cumulative average abnormal returns in different countries

From an investor's point of view, the best chances to gain excess returns are at Danish market. On average, the abnormal returns around the ex-dividend day are highest in Denmark. However, as reported in section 5.1, the variation in PDRs is also highest in Denmark, indicating simultaneously the highest risk on returns on ex-day. The results indicate that simply by holding a stock for an 11-trading day period an investor could on average earn over 1% excess return. Since this return is an average of large sample, it cannot be considered as an advice for all individual shares. In Finland, the best excess return could be achieved by a acquiring a stock about a week before the dividend detachment and sell it at the end of ex-day at latest. After ex-day, the returns in Finland seem to turn negative. In Sweden, markets seem to act efficiently around the ex-dividend day leaving no room for significant excess return. The analysis shows that both AARs and CAARs are systematically insignificant in Sweden. Therefore, based on the Swedish sample, naming a trading strategy that would yield statistically significant returns around ex-day is impossible.

Since dividend yield seemed to make difference in PDRs based on earlier analysis, the same can be investigated with abnormal returns. Table 11 presents the results of observed AARs, when the sample is divided to two parts based on median dividend yield.

Table 11: Average abnormal returns in high and low dividend yield stocks

	Finland		Denmark		Sweden	
	DY>M_d	**DY<M_d**	**DY>M_d**	**DY<M_d**	**DY>M_d**	**DY<M_d**
Time	**AAR (%) (t-value)**	**AAR (%) (t-value)**	**AAR (%) (t-value)**	**AAR (%) (t-value)**	**AAR (%) (t-value)**	**AAR (%) (t-value)**
-5	0,184 (1,46)	0,058 (0,45)	-0,182 (-1,07)	-0,301* (-1,96)	0,082 (0,80)	0,045 (0,30)
-4	-0,070 (-0,56)	0,153 (1,19)	0,059 (0,35)	0,106 (0,69)	0,104 (1,02)	0,019 (0,13)
-3	0,217* (1,73)	0,150 (1,17)	0,116 (0,69)	0,181 (1,18)	0,105 (1,02)	0,013 (0,09)
-2	0,293** (2,34)	0,052 (0,41)	0,206 (1,22)	0,023 (0,15)	0,103 (1,00)	0,055 (0,37)
-1	0,321** (2,56)	0,027 (0,21)	0,318* (1,88)	0,068 (0,45)	-0,158 (-1,54)	-0,121 (-0,81)
0	-0,080 (-0,63)	0,274** (2,12)	0,435** (2,57)	0,352** (2,29)	-0,156 (-1,51)	0,398*** (2,70)
1	-0,227* (-1,81)	-0,080 (-0,62)	-0,079 (0,64)	0,207 (1,34)	-0,016 (-0,15)	0,186 (1,26)
2	0,045 (0,36)	-0,072 (-0,56)	0,282* (1,67)	0,040 (0,26)	-0,132 (-1,28)	0,117 (0,80)
3	-0,069 (-0,55)	0,015 (0,12)	0,039 (0,23)	0,024 (0,16)	0,026 (0,25)	0,144 (0,98)
4	0,182 (1,46)	-0,086 (-0,67)	0,140 (0,83)	0,061 (0,40)	0,110 (1,07)	-0,019 (-0,13)
5	-0,001 (-0,01)	-0,255** (-1,97)	-0,016 (-0,09)	0,206 (1,34)	0,001 (0,01)	-0,183 (-1,24)

Note: ***, **, * indicate significance at 1%, 5% and 10% levels, respectively

Based on the table above, remarkable differences between high and low dividend yield stocks are hard to find. In most cases the abnormal returns observed are quite similar between groups, but some differences can be captured. For example, evidence from Finnish market shows signs of higher abnormal returns in high yielding stocks during days -2 and -1. These returns are also statistically significant at 5% risk level. The higher abnormal returns in high yielding stocks can again be explained with desire of dividend income. When demand for dividends increases, the market prices of high yielding stocks tend to increase, causing simultaneously positive abnormal return in those shares, like suggested already by Lakonishok & Vermaelen (1986). Similarly, in Denmark the returns of high yielding stocks are positive and statistically significant on cum-day, unlike the ones of low yielding stocks. Based on taxation, Danish people should be indifferent between dividends and capital gains, but higher demand in better yielding stocks can be explained with other factors. For instance, assuming the assumptions of bird-in-the-hand and signalling hypotheses to hold, investors would rather receive their returns as dividends. Therefore, it could be expected that investors seek investment opportunities from stocks with high dividend yield before the dividend detachment, pushing the stock prices higher and causing abnormal return to those shares.

Swedish market shows no signs of statistically significant returns before the ex-day in either of the sub-categories. Couple of days after the dividend detachment, returns in high dividend yield shares are negative, while in low yielding shares the returns are positive. This could be explained with higher sales in high yielding stocks, meaning simultaneously that investors are willing to abandon their holdings after receiving the dividend. However, these results are statistically insignificant. The only statistically significant return in Sweden can be found on ex-day, where low yielding shares seem to provide positive return. In fact, the corresponding ex-day return is positive and statistically significant in Finland and Denmark as well. On the other hand, ex-day abnormal return of high yielding stocks seems to be negative and statistically insignificant in Finland and Sweden, but in Denmark it stays positive and significant. These observations are in line with the analysis made on PDRs. Evidence from Finland and Sweden indicate that excess returns are more likely to be captured in low dividend yielding stocks. This may be due to higher demand for dividend income, mostly in Finland however, which causes the excess return on ex-day to melt off since stock prices have already faced an excessive increase for a couple of days before the ex-day.

Similarly, the comparison between high and low dividend yield stocks can be made based on cumulative abnormal returns. The results have been gathered to table 12.

Table 12: Cumulative average abnormal returns in high and low dividend yield stocks

	Finland		Denmark		Sweden	
	DY>M_d	DY<M_d	DY>M_d	DY<M_d	DY>M_d	DY<M_d
Day	**CAAR (%) (J_1)**	**CAAR (%) (J_1)**	**CAAR (%) (J_1)**	**CAAR (%) (J_1)**	**CAAR (%) (J_1)**	**CAAR (%) (J_1)**
(-5…-1)	0,946***	0,441*	0,517*	0,077	0,235	0,011
	(3,38)	(1,53)	(1,37)	(0,22)	(1,02)	(0,03)
(-1…0)	0,241*	0,301**	0,752***	0,420**	-0,314**	0,277*
	(1,36)	(1,65)	(3,14)	(1,93)	(-2,16)	(1,33)
(-1…1)	0,014	0,221	0,673***	0,627***	-0,330**	0,463**
	(0,06)	(0,99)	(2,30)	(2,35)	(-1,85)	(1,82)
(0…5)	-0,150	-0,204	0,800**	0,890***	-0,166	0,643**
	(-0,49)	(-0,64)	(1,93)	(2,37)	(-0,66)	(1,78)
(1…5)	-0,070	-0,478**	0,366	0,538**	-0,010	0,245
	(-0,25)	(-1,66)	(0,97)	(1,57)	(-0,04)	(0,75)
(-5…5)	0,796**	0,237	1,317***	0,967**	0,069	0,654*
	(1,92)	(0,55)	(2,35)	(1,90)	(0,20)	(1,34)

Note: ***, **, * indicate significance at 1%, 5% and 10% levels, respectively

The observation of CAARs gives yet again interesting insight on stock market behaviour and its differences between countries. By looking at the last row in table 12, it can be obtained that in Finland and Denmark, stocks with higher dividend yield seem to provide also higher cumulative abnormal return during the 11-day period around the ex-day. On the other hand, in Sweden the situation is totally opposite. Based on Finnish and Danish evidence, it seems that higher abnormal returns in high yielding stocks is mostly accrued before ex-day, starting from which the development is quite similar. The only noticeable difference after the ex-day can be found in Finland, where cumulative return from day +1 to +5 seems to be significantly lower with low yielding stocks. However, by looking back at the table 11 it can be seen that majority of this difference is explained by the development in day +5 only. The price development before ex-day gives an advantage of approximately 0,5 percentage points in both Finland and Denmark for high yielding stocks, and the difference remains reasonably same until the end of the event window. Again, dividend-seeking investors could be used to explain this phenomenon.

The opposite evidence from Sweden can be explained with the development on and after the ex-day. Cumulative abnormal returns in high yielding shares are only slightly higher during

the period before ex-day, and also statistically insignificant. Starting from ex-day, stocks with lower dividend yield seem to systematically accumulate higher CAARs, which in most cases are statistically significantly positive. Simultaneously, CAARs in high yielding stocks are negative or otherwise really low, which causes differences in all sub-periods after the dividend detachment. By going back to table 11, it can be deduced that most of the difference in CAARs can be explained with ex-day development, when low dividend yield stocks seem to generate significantly higher average abnormal return in Sweden than stocks with high dividend yield. Hence, the anomalistic market behaviour of low dividend yield shares opens possibilities for excess returns at Swedish market.

All in all, different market behaviour between Nordic countries around the ex-dividend day makes it hard to name one clearly profitable trading strategy. What seems to be profitable in Finland may not work well in Denmark and Sweden, and vice versa. Also, the observation of abnormal returns shows some signs of dividend-seeking behaviour, especially in Finland. Finnish tax legislation makes it more favourable to have earnings as dividends than as capital gains, so it is reasonable to expect that investors also behave in such way. Minimizing taxes maximises the amount of available money, so it is reasonable to make moves supporting this in investment world as well.

5.3 Regression results

In this section, the focus is transferred to company-level factors that may explain the magnitude of ex-dividend day price drop and thus the observed abnormal returns on ex-day. For this purpose, two different regression models with AR_0 as dependent variable are constructed and tested country by country. Before running the regressions, outlier observations of explanatory variables are cleaned from the dataset. An example of clear observation can be found from Danish sample, from variable DY. The highest observed dividend yield in Denmark was 65,5%, while second highest was only 12,5%. These outlier observations may cause biased results, and in worst case effect the regression outcome even dramatically. Also, removal of them should help in generalizing the model, and possibly help to increase the explanatory power. However, sometimes outliers may also include valuable information, which is why justified overall consideration should be used when

excluding observations (Frost 2019). The detection of outliers is implemented in this study by using box plots. Model 1 in this paper is a simple linear regression model, using the dataset with outliers removed in each country and including all variables presented earlier in equation 29. Model 2 is a stepwise estimation including the same observations, using the backward selection, and leaving only variables with p-value greater than 0,3 to final model. This is done to exclude the variables with really low explanatory power off from the regression equation.

In table 13, the results from Finnish sample are presented, including coefficients of each variable, and their t-values reported in parentheses. Both models seem to suffer from heteroscedasticity, so robust standard errors are used. Also, assumption of normally distributed residuals is violated, but the sample is sufficiently large compared to number of explanatory variables, so this is not a severe issue. Autocorrelation or multicollinearity was not detected.

Table 13: Regression results from Finland

	Model 1	Model 2
Intercept	-0,002 (-0,41)	0,002 (0,60)
DY	-0,143** (-2,27)	-0,177*** (-3,32)
MC	$8{,}56 \times 10^{-8}$ (0,91)	-
P/E	$7{,}95 \times 10^{-5}$ (0,97)	-
Liquidity	0,023 (0,59)	-
Volatility	0,020* (1,84)	0,021** (2,06)
RE	0,004 (0,83)	-
MTB	$-1{,}29 \times 10^{-4}$ (-0,24)	-
TR	-0,147 (-1,13)	-0,145 (-1,32)
R^2	0,064	0,056
F-stat	3,07***	7,35***
N	359	359
White	<0,01	<0,01
DW	2,12	2,12
SW	<0,01	<0,01
VIF	1,34	1,1

Note: ***, **, * indicate significance at 1%, 5% and 10% levels, respectively

The cross-sectional results from the Finnish sample show that only few variables seem to have statistically significant explanatory power on dependent variable. In fact, only dividend yield and volatility seem to have significant impact on ex-day abnormal returns according to regressions. In addition, most variables seem to have positive relation to explained variable, since dividend yield, market-to-book ratio and turnover ratio were the only ones with negative relation to explained variable. Concerning the impact of dividend yield, the observation of negative relation to abnormal returns matches with expectations derived from previous section, since higher abnormal returns were observed in stocks with low dividend yield. Dupuis (2019) found the risk level of a certain stock to have positive relation with abnormal returns, and Santos (2017) reported results that indicated highly volatile stocks to have lower PDR on ex-day. Thus, the observed positive relation between volatility and ex-day abnormal returns is in line with other studies. From the rest six variables explanatory power on ex-day abnormal returns was not found, despite that some of these variables have been found significant in earlier literature. For example, Santos (2017) measured liquidity in a similar manner as was done in this study and reported highly significant negative relation between liquidity and PDR on ex-day. Since abnormal returns and PDRs tend to move to opposite directions, the relation between liquidity and abnormal returns could have been expected to be positive and statistically significant, but this was not observed. On the other hand, some findings about the lack of explanatory power in some variables are in line with previous literature. Liljeblom et al. (2001) for example found no statistically significant relation between ex-day returns and trading volume, which is to some extent comparable to turnover ratio-variable of this paper.

When observing the regression results from the Finnish sample as a whole, it seems evident that all models have relatively low explanatory power. Despite having 8 different explanatory variables with low mutual correlation, the R^2 values seem to be really low, only about 6% on average. This is quite close to corresponding ones by Dasilas (2009) but falls short from the ones reported by Dupuis (2019), who achieved almost 50% explanatory level. However, it was known already beforehand that capturing even the majority of variables with explanatory power to the regression equation is an extremely challenging task.

Results from the Danish sample are presented in table 14. Unlike in Finland, in Danish sample the homoscedasticity assumption seems not to be violated. Again, normality in

residuals is not achieved but not considered as an issue. Neither multicollinearity nor autocorrelation was detected.

Table 14: Regression results from Denmark

	Model 1	Model 2
Intercept	0,014*** (3,02)	0,012*** (3,62)
DY	-0,200** (-2,29)	-0,195** (-2,37)
MC	$1{,}04 \times 10^{-8}$ (1,15)	$1{,}03 \times 10^{-8}$ (1,22)
P/E	$5{,}20 \times 10^{-6}$ (0,08)	-
Liquidity	$-1{,}50 \times 10^{-5}$ (-0,39)	-
Volatility	-0,006 (-0,68)	-
RE	-0,007* (-1,86)	-0,008** (-2,32)
MTB	$-5{,}49 \times 10^{-4}$** (-2,42)	$-5{,}15 \times 10^{-4}$** (-2,53)
TR	0,133 (1,38)	0,122 (1,3)
R^2	0,049	0,046
F-stat	1,41	2,15**
N	229	229
White	0,27	0,14
DW	2,13	2,14
SW	<0,01	<0,01
VIF	1,41	1,29

Note: ***, **, * indicate significance at 1%, 5% and 10% levels, respectively

Results from Danish sample show some differences to what was observed based on Finnish sample. For example, variables like market-to-book ratio and retained earnings seem to be negatively related to ex-day abnormal returns, and also in a statistically significant way. Also, variables like liquidity, volatility and retained earnings seem to have opposite coefficients compared to results obtained in Finland. However, a noticeable similarity between Denmark and Finland is that dividend yield has significant negative relation to explained variable. This finding matches with expectations and consensus derived from previous literature. However, when having a look at previous studies made in Denmark, some conflicting observations can be made. For instance, Akhmedov & Jakob (2005) found no evidence on positive correlation between dividend yield and PDRs in Denmark, which

would theoretically mean that the relation to abnormal returns should also be statistically insignificant. Based on the results of regressions above and the analysis on earlier sections, it can be stated that significant negative relation between dividend yield and ex-day returns exists also in Denmark.

The regression results indicate also that market-to-book ratio seems to have significant effect on ex-day abnormal returns. Previous literature recognizes poorly papers where this relationship had been tested, but for example Santos (2017) argued that it should be positively but statistically insignificantly related to PDR. Thus, negative relation to abnormal returns is logical. Retained earnings seem also to be negatively related to ex-day abnormal returns, indicating that companies with more gentle dividend policy produce higher returns on ex-day. This is surprising, keeping in mind that increase in dividend yield is considered to affect negatively to ex-day returns. Concerning statistically insignificant variables, for example market capitalization was not found to have explanatory power to ex-day returns. Previously, authors like Wu & Hsu (1996) and Dasilas (2009) have also not found statistically significant explanatory power from company size. The results from Finnish sample earlier support this finding.

Unlike in Finland, the intercepts of the regressions seem to be highly significant in Denmark. This could be rationalized with what has been observed in earlier sections. Since Danish PDRs seem to be really low and ex-day abnormal returns high, it is possible that positive abnormal returns exist also in a general level, leading to significant positive intercept in the regression model. However, similarly as in Finland, it needs to be taken into account that the models created seem to have reasonably low explanatory power. In fact, based on the F-statistic, model 1 seems even to be statistically insignificant. The explanatory power of the models seems to be lower than in Finnish sample, since R^2 values are below 5%. This supports the observation made already based on Finnish sample that the company-level financial factors do not have large aggregate influence on ex-day abnormal returns.

Last, the results from Swedish sample are gathered to table 15. The basic assumptions are met reasonably well, and only normality assumptions seems to be violated. Again, this is not an issue thanks to sufficiently large sample.

Table 15: Regression results from Sweden

	Model 1	Model 2
Intercept	-0,003 (-0,78)	-0,003 (-1,12)
DY	-0,092** (-2,02)	-0,097** (-2,20)
MC	4,58 x 10^{-9} (0,76)	-
P/E	9,56 x 10^{-5}** (1,97)	1,10 x 10^{-4}*** (2,65)
Liquidity	0,001 (0,19)	-
Volatility	0,018** (2,08)	0,016** (1,88)
RE	-0,002 (-0,55)	-
MTB	3,95 x 10^{-5} (-0,20)	-
TR	0,006 (0,17)	-
R^2	0,033	0,030
F-stat	1,84*	4,59***
N	444	444
White	0,75	0,77
DW	1,88	1,87
SW	<0,01	<0,01
VIF	1,29	1,02

Note: ***, **, * indicate significance at 1%, 5% and 10% levels, respectively

Results from Sweden seem to have some similarities to both Finland and Denmark, but simultaneously have some unique attributes as well. Like observed from Finnish sample, volatility seems to provide statistically significant positive explanatory power to ex-day abnormal returns. Also, like expected, the relation between dividend yield and abnormal returns is negative. Most variables seem to have positive relation to dependent variable. Alongside dividend yield, only retained earnings seem to be negatively related to abnormal returns.

A unique characteristic in Swedish sample is that P/E ratio seems to provide statistically significant explanatory power to ex-day abnormal returns. This is conflicting with findings from Finland and Denmark. Previously, Neskova (2021) has reported results from Latvian market that showed statistically significant relation between P/E ratio and abnormal returns. However, the relation was opposite since P/E ratio had negative coefficient. Based on results

from Finnish and Danish sample, the positive relation cannot be considered surprising, but statistically significant effect was unexpected.

Like previous models, the Swedish sample seems to suffer from low explanatory power as well. R^2-values are approximately only 3%, which is the lowest level observed in this study. Also, looking at F-statistics, model 1 seems to be only weakly statistically significant. Model 2 with stepwise estimation seems to achieve higher levels in terms of significance, which on the other hand is expected due to methodological reasons. Even though the case of low explanatory power was similar in all models previously as well, this should not be considered as a failure. The target was to investigate the company-level financial factors that could possibly explain the ex-dividend day abnormal returns. It may be the case that financial factors can only weakly explain the price fluctuation on ex-day, which reflects as low overall explanatory power in regression models.

When summing up the results, the strongest evidence on significant explanatory power can be found on dividend yield and volatility. However, it needs to be highlighted that the results are not exclusive, and the overall explanatory power achieved was low. It seems, that stocks with lower dividend yield produce higher abnormal returns on ex-day, just like observed in earlier sections. The impact of dividend yield seems to be reasonably similar in all countries based on regression results. Also, highly volatile stocks may generate higher abnormal returns on ex-day. This was confirmed clearly evident in Finnish and Swedish samples. Hence, based on the observations of this study, investors should prefer stocks that pay relatively low dividend and are volatile, when trying to capture the excess returns on ex-day. With this strategy, the excess return earned is more likely higher. However, it needs to be taken into account that high dividends are in many ways safer form of return, which can explain the investors desire for them, like stated by agency cost argument. Trying to capture the excess returns is highly risky in real world, and due to anomalistic nature of ex-day price behaviour it is impossible to list factors that may cause either higher or lower returns during the dividend detachment. Anyway, the results of the regressions indicate that higher abnormal returns could be found from highly volatile and low dividend paying stocks.

6. Conclusions

In this paper, the ex-dividend day stock price behaviour was analysed at three major Nordic markets, Finland, Denmark, and Sweden. A comparative approach was assumed to be interesting thanks to low cultural and political differences between the countries. The investigation process was made from investor's perspective. One of the key targets was to observe, what kind of opportunities exist at the markets around the ex-dividend day, and with what strategy investors could try to benefit from the anomaly. Roughly speaking, the study consisted of two major parts. First, the theoretical framework around the ex-dividend day anomaly was introduced and possible reasons for dividend payments as a form of profit distribution observed on a general level. The second major part consisted of empirical study conducted with selected sample.

When getting familiar with previous literature concerning the ex-dividend day anomaly, it became clear that prices on ex-day often drop by less than the dividend amount. This has encouraged many researchers to seek reasons for this market imperfection, which could also help skilled investors to achieve arbitrage-like returns. Previous literature recognizes four different theories to explain the anomaly, but according to the careful literature review it became clear that studies at different markets have shown both supporting and destabilizing evidence for all theories. In this paper, the target was not specifically to fit any of these theories to the data, but especially the framework of two earliest theories, i.e., tax-effect hypothesis and short-term trading hypothesis was used when trying to find reasons for the price behaviour around the ex-dividend day. Also, the theoretical background of dividend policy theories was used to explain the investor's behaviour during the same period.

The results of this study indicate that ex-dividend day anomaly exists at Nordic markets and similarly as previous literature suggests, the price drop ratio is below 1. Due to this inefficiency, opportunities for earning excess returns arise. However, PDRs reported in this paper were across the board higher than what was previously reported in same markets, by Sorjonen (1988) Akhmedov & Jakob (2005) and Daunfeldt (2002), for instance. Lowest price drop ratios were observed in Denmark, where stock prices seem to drop significantly less than in Finland or Sweden, thus providing the best possibility to gain from the anomaly.

Finnish and Swedish markets seem to be more efficient around ex-day, and price drop was noticed to be in these countries reasonably close to one, leaving thus less room for excess profits. Also, the results of this study coincide with corresponding ones of Elton & Gruber (1970) and Kalay (1982) for example, since the price drop ratio seems to be higher when dividend yield is increased. However, the theory of Elton & Gruber (1970) was not observed to be sufficient to explain the price formation on ex-dividend day, since differences in dividend and capital gain taxation seem to be incapable to predict the magnitude of ex-day price drop.

When investigating abnormal returns around the ex-dividend day, noticeable differences between countries were observed. In Finland, abnormal returns seemed to be positive before ex-dividend day, but turn negative afterwards, similarly as reported by Dasilas (2009) and Eades et al. (1984). This is in line with assumptions of short-term trading hypothesis, since investors seem to be attracted by dividend income and hence give stock prices upward pressure before the dividend detachment. In Denmark, the abnormal returns were mainly positive around the ex-dividend day, and in Sweden they were not observed to statistically significantly differ from zero. Stocks with higher dividend yield seemed to provide higher abnormal returns before ex-dividend day, but on event day the returns were higher with low dividend yield stocks.

Finally, the results from cross-sectional regression analysis show that dividend yield and volatility play the most significant role in ex-dividend day stock price determination. Dividend yield seemed to be negatively related to ex-day abnormal returns, whereas between volatility and dependent variable the relation was positive. However, the results between different countries were contradictory, and the level of explanatory power was relatively low. In this sense, the results from this paper indicate that the ex-dividend day anomaly stays as an anomaly also from now on, since at least company-level financial factors offer poor overall explanatory power for ex-day price fluctuation. Anyway, a few of these factors seem to own statistically significant individual impact on ex-day returns.

In further research, the models used in this paper could be taken a one step further. For instance, when examining the abnormal returns on and around the ex-day, the effect of ancillary costs like from transactions could be taken into account. Like presented by Castillo

& Jakob (2006) and Dasilas (2009), significant transaction costs prevent the price drop to equal the dividend amount, since arbitrageurs are affected by these associated costs. Thus, this also affects the realized abnormal returns in real world circumstances. Also, the effect of other factors to ex-day abnormal returns could be tested, since in this study the explanatory level achieved was low. Alongside financial factors, there are multiple other possible determinants that could be added to the model. It would be interesting to see, does the cross-listing or belonging to dividend aristocrats effect both price drop and abnormal returns on ex-dividend day. Last, in further research it could be investigated how the magnitude of the anomaly changes in time, for instance during and after the financial crisis. Do investors act similarly when markets are in turmoil and do they under restless circumstances for instance try to capture more heavily dividends, which could influence the price fluctuation around the ex-day and open different kind of earning opportunities.

All in all, this research achieved its objectives reasonably well. All research questions were answered, some more in detail than others. The ex-dividend day anomaly was noticed to occur differently between Nordic countries, and legislative factors were not observed to provide accurate explanatory power for the anomalistic price behaviour on ex-day. Naming the company-level financial factors effecting the anomaly turned out to be a bit challenging, but some significant explanatory power was detected in a few variables, most in dividend yield. When trying to benefit from the anomaly, it was observed that one exclusive trading strategy does not exist. In Finland, the best strategy would be acquiring stocks with high dividend yield about a week before dividend detachment and sell the stocks immediately after the dividend has detached. Thus, an investor could benefit from the sharp price increase before ex-day. In Denmark, simply by holding a stock for a two-week period around the ex-day an investor could on average achieve excess returns, but highest ones of them were observed on ex-day. In Sweden, the returns were lowest, but the best strategy would be to acquire low dividend yielding stocks at the end of cum-day and sell them on ex-day, benefiting thus from the low price drop. However, the results in this paper are based on historical stock performance and are not a guarantee on future development. Also, the effect of transaction costs was not taken into account, which decreases the possible returns in a real world.

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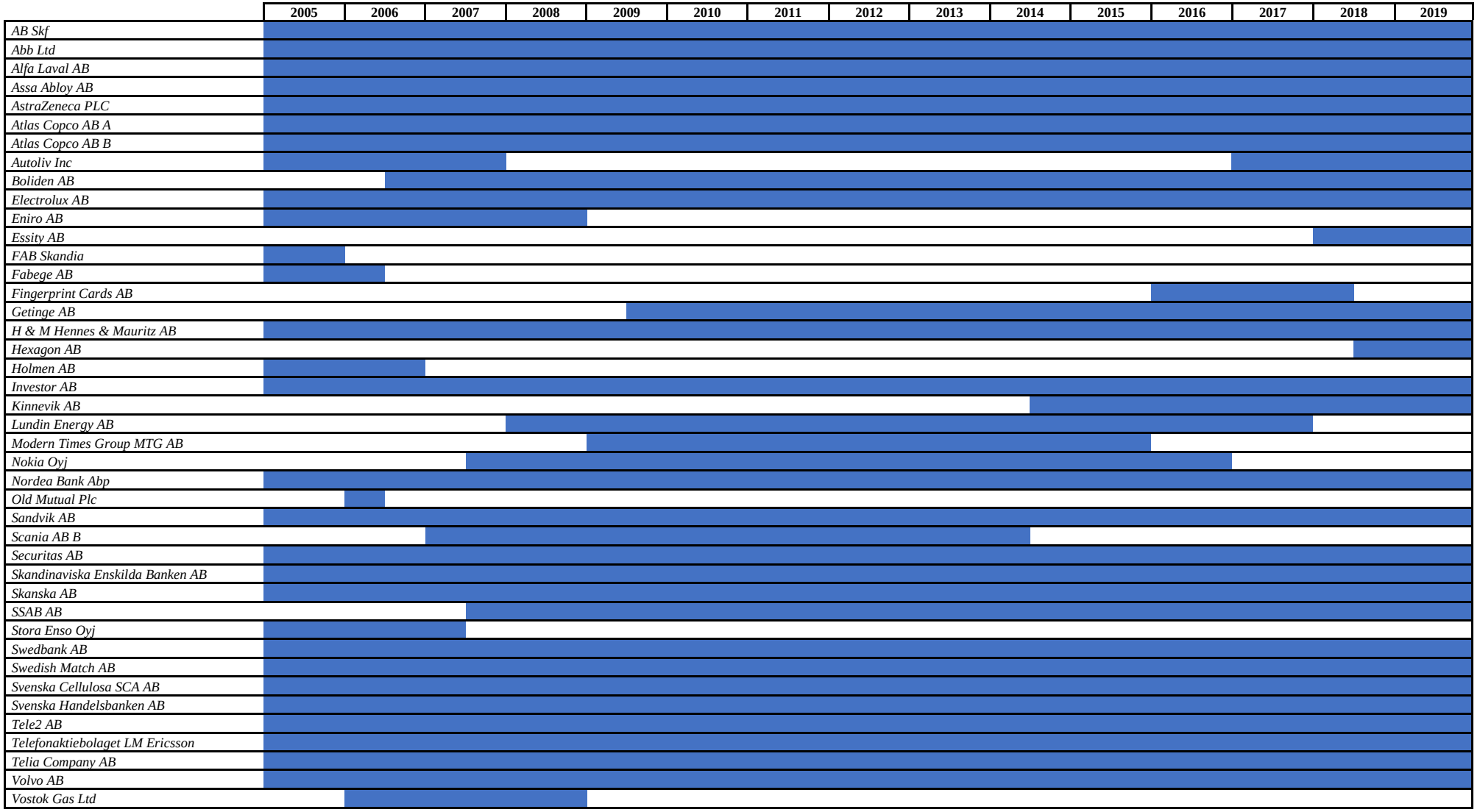
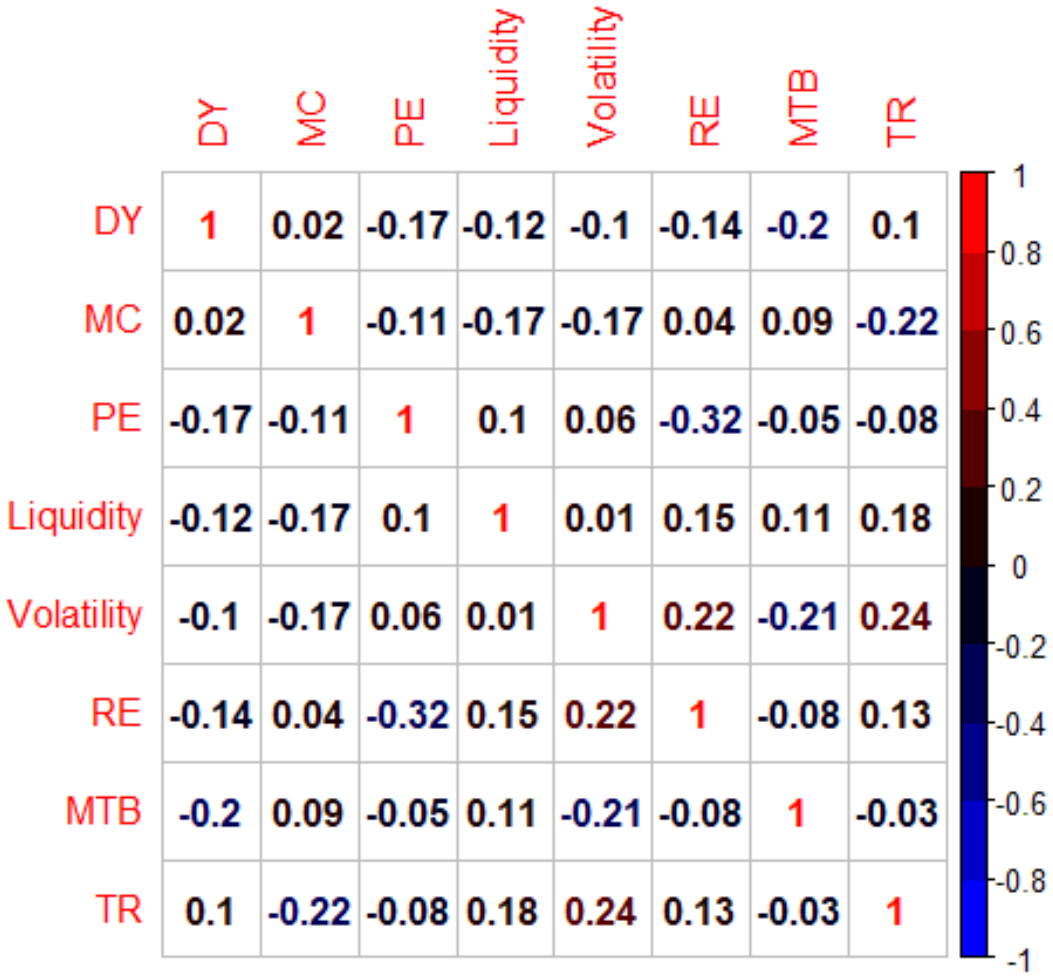
Appendix 1: Constituents of OMX Helsinki 25 index between 2005 and 2019 (blue=included)

Appendix 2: Constituents of OMX Copenhagen 20 index between 2005 and 2019 (blue=included)

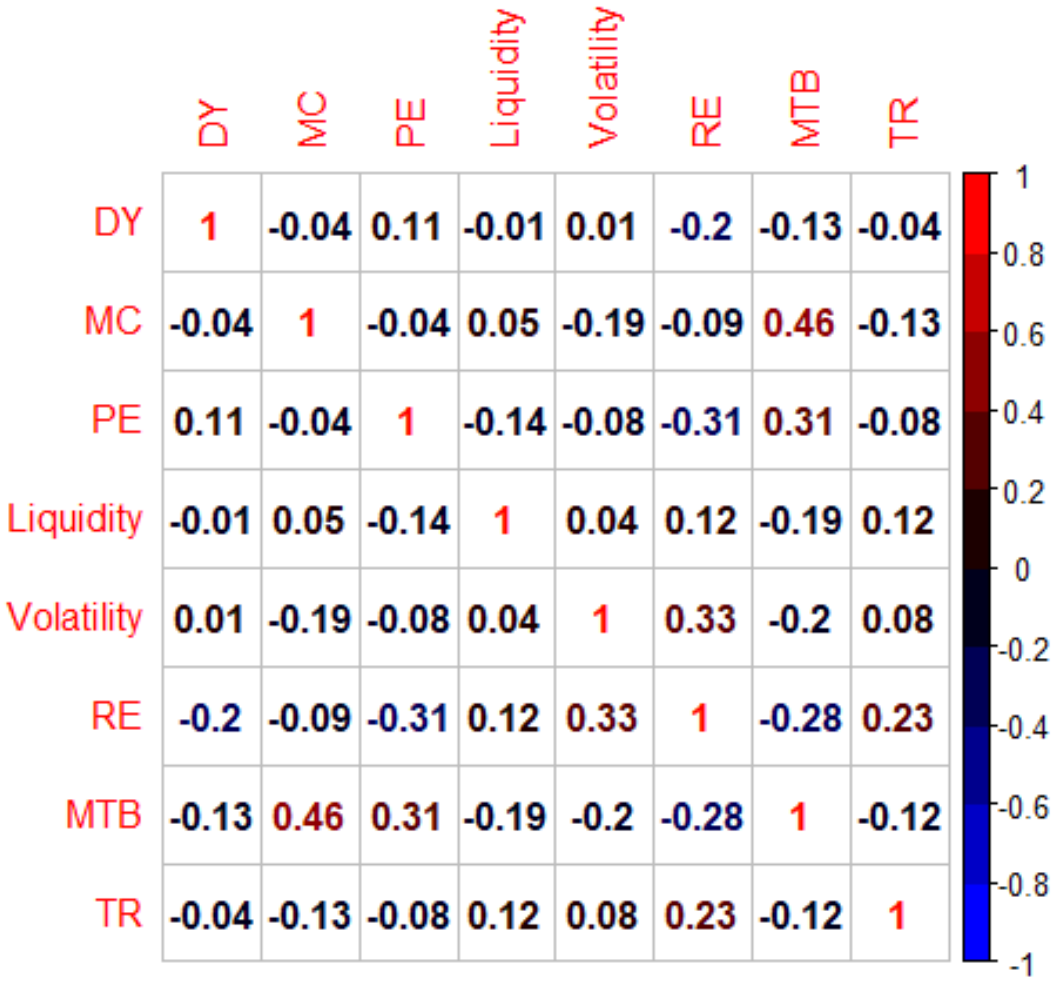
Appendix 3: Constituents of OMX Stockholm 30 index between 2005 and 2019 (blue=included)



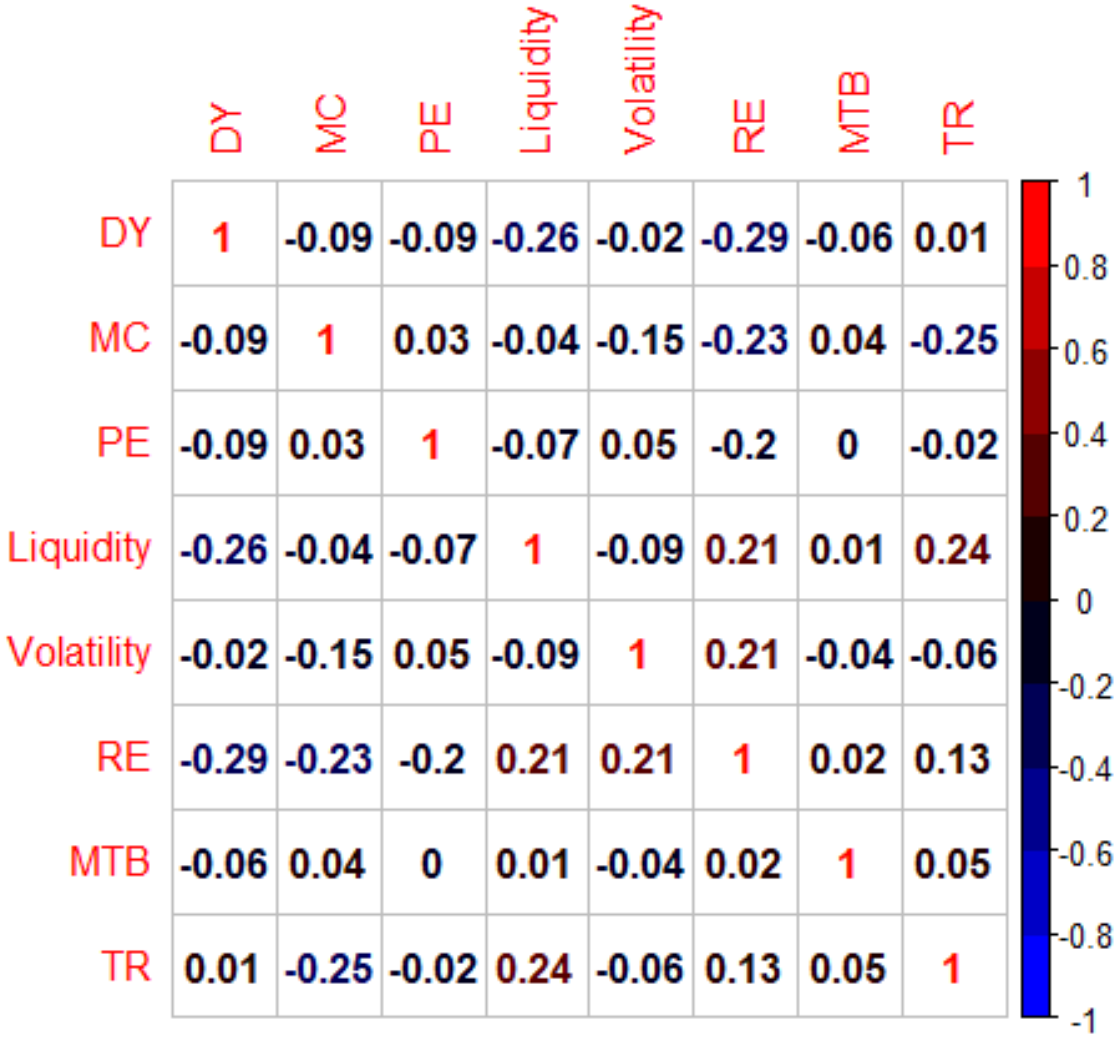
Appendix 4: Correlation matrix for Finnish sample



Appendix 5: Correlation matrix for Danish sample



Appendix 6: Correlation matrix for Swedish sample



Appendix 7: Calculations of variables

Variable	Abbreviation	Formula
Dividend yield	DY	$\frac{Dividend\ per\ share}{Cum-day\ stock\ price}$
Market capitalization	MC	$Ex-day\ share\ price\ *\ Number\ of\ shares\ outstanding$
P/E	PE	$\frac{Ex-day\ share\ price}{EPS\ of\ last\ fiscal\ year}$
Liquidity	LIQ	$Ex-day\ price\ (Ask)\ -\ Ex-day\ price\ (Bid)$
Volatility	VOL	$5-year\ average\ annual\ price\ movement\ of\ stock\ i$
Retained earnings	RE	$1-\frac{Dividend\ per\ share\ (annual)}{Earnings\ per\ share\ (annual)}$
Market-to-book ratio	MTB	$\frac{Market\ value\ of\ the\ company\ (ex-day)}{Book\ value\ of\ the\ company\ (last\ reported\ quarter)}$
Turnover ratio	TR	$\frac{Ex-day\ trading\ volume}{Number\ of\ shares\ outstanding}$