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THE EX-DIVIDEND DAY ANOMALY IN ILLIQUID MARKETS: EVIDENCE FROM THE BALTIC STATES

Master's thesis

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Supervisor: Karsten Staehr, PhD

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ABSTRACT

It is widely assumed that on the ex-dividend day a stock price should decrease by a dividend amount. Any significant deviation from such is called the ex-dividend day anomaly. The aim of the thesis is to identify factors that affect Baltic stock prices on the ex-days and assess the possibility to turn the phenomenon into investors' favor. The sample consists of stocks of the main and secondary lists of Tallinn, Riga and Vilnius stock exchanges and covers 2000-2020. The methodology used in the analysis is event study. Among various theories the thesis focuses on tax-induced and short-term trading propositions. The empirical analyses reveals that the anomaly persists in all three markets. However, there is no supportive evidence of taxes being the factor that determines the extent of a price drop in the Baltic markets. On the contrary, the results imply that dividend capturing strategies are being implemented on Tallinn and Vilnius stock exchanges. Price drop of Estonia sample is approximating dividend amount for stocks with smaller market capitalization, lower risk and higher dividend yield and illiquidity. Vice versa, Latvian stocks with higher market capitalization adjust more perfectly. Similarly to Estonia sample, stocks traded on Vilnius stock exchange that are high in illiquidity and low in size provide lower premiums. The robustness of the impact of dividend yield on Lithuanian stocks is questionable. In overall, the findings imply that it is possible to exploit the anomaly, especially on Riga and Vilnius stock exchanges.

Keywords: ex-dividend day anomaly, ex-dividend day, abnormal trading volumes, abnormal returns, price-drop ratio

INTRODUCTION

The market efficiency has always been under increased attention. Among other phenomena, stock price behavior on the ex-dividend day is considered to be an evidence of market imperfection. In the flawless environment once a stock goes ex-dividend the price should decrease by a value of a distributable profit. However, this is not always the truth. During almost a century a number of studies have been conducted with intention to find an explanation why stock prices decrease by less than a dividend amount on the ex-dividend day, but conclusive evidence common for all countries has not been found.

Empirical papers in most examine such major markets like US or UK, while few have considered relatively small and illiquid markets including those in the Baltic states. Thus, the aim of the thesis is to determine which factors affect Baltic stock prices' behavior on the ex-dividend day and assess the possibility to benefit from it. Given a few quite aged studies, changes in taxation and overall development of the Baltic countries, it is worthwhile examining the ex-dividend day anomaly persistence and its' dynamics in the case of Estonia, Latvia and Lithuania.

In the thesis the author attempts to find answers for the following research questions:

1. To what extent Baltic stock prices are affected by ex-dividend days?
2. Which fundamental measures of a company, in addition to tax heterogeneity, risk, transaction costs and illiquidity, may have an impact on stocks' abnormal returns?
3. Do investor realize and exploit the opportunity arisen from such market shortcoming in case of its' existence?

The data used in the study was mainly collected from 2 sources: Nasdaq Baltic and financial statements of companies. The methodology used to achieve the tasks of the thesis is event study with applied pooled ordinary least squares regression analysis conducted in EViews11. The sample contains companies of Estonia, Latvia and Lithuania that were listed in the main and secondary lists on Nasdaq Baltic exchanges and paid dividends during 2000-2020. The period is long enough to examine how the global financial crisis influenced the way in which Baltic stocks behave on ex-days.

The thesis is divided into three chapters. The first chapter gives an overview of theoretical explanations of the anomaly and empirical studies conducted in different markets. It also discusses the changes in taxation of capital gains and dividends for Estonia, Latvia and Lithuania. In addition, trading and market trends for last two decades of Baltic exchanged are presented.

The second chapter describes the data used in estimation and points out its' limitations. It also explains the methodology and calculation of variables used in the analysis.

In the third chapter the main results of the study are presented. All three Baltic countries are treated separately. The final section of third chapter summarizes the findings for Estonia, Latvia and Lithuania.

The author would like to thank her supervisor professor Karsten Staehr for enormous support, helpful discussions, and guidance in principles of econometrics. The author is also grateful to Laima Viškinte from Nasdaq Baltic for providing data that was no longer publicly available.

1. EX-DIVIDEND DAY ANOMALY, TAXATION AND STOCK MARKET FEATURES OF THE BALTIC STATES

1.1. Ex-dividend day anomaly and what may explain it

It is commonly expected a stock price to decrease by around a dividend amount on the ex-dividend day, as a potential buyer will no longer be eligible to receive a dividend on the upcoming payment date. But in fact, this is not what has always been observed on stock markets. A price drop of less than it is supposed to be was documented already in 1950s, what led to the conclusion that it might be possible for market participants to turn this anomaly in their own favour. (Campbell, Beranek 1955, 427) As a corollary, market premiums driven by the phenomenon violate perfect capital market assumption.

Main features of "perfect capital markets" are indifference between tax rates on capital gains and dividends, absence of transaction costs and inability for market participants to impact stock prices. On perfect markets investors are rational, i.e., they are focused on profit maximization disregarding whether a part of wealth is received in form of dividends or as an increment in value. (Miller and Modigliani 1961, 412). Miller and Modigliani in their paper demonstrated that under perfect market assumptions application of well-known methods used to determine enterprise value gives idem results and, as current dividend payout is just a form of profit distribution, which proportionally decreases each investors' share in the company, this should not have an effect on a stock price more than an amount of a paid-out dividend. However, the authors note that unequal taxation treatment of capital gains and dividends applied to investors is the main market systematic imperfection that may force to prefer one to another and derive stock prices from their "fair value". Nevertheless, this aberration will dissipate by newly attracted "clientele", who prefer this specific dividend policy given the tax rates they are subject to, e.g., if dividends are taxed at a higher rate than capital gains, an individual or a corporation should opt for low yielding stocks. (Ibid.)

The assertion of tax-induced dividend clientele became a reference point for the theory of ex-dividend day stock price behavior proposed by Elton and Gruber (1970). Investor's rational behavior undermines that only profit net of taxes should be considered. Thus, there will be no difference between selling a stock before it goes ex-dividend at a higher price, whilst losing a dividend, and selling on the ex-dividend day (or later) at a lower price, but retaining the right to receive a part from company's distributable profit, only if the following equation holds (Ibid., 69):

$$P_c - t_g(P_c - P_a) = P_e - t_g(P_e - P_a) + D(1 - t_d) \qquad (1.1)$$

where

P_c – price on the cum-dividend day
P_a – acquisition price of a stock
P_e – price on ex-dividend day
D – dividend amount per stock
t_g – the tax rate on capital gains
t_d – the tax rate on dividend income

The left side of the equation determines income received, if a stock is traded ex-dividend, and the right side is wealth obtained once a security is traded on the cum-dividend day. Any deviation from such equilibrium will lead to unfavorable deal outcomes making a seller or a buyer postpone a trade from execution (Ibid., 70). Consequently, after rearrangement it becomes obvious that expected price drop is defined by marginal stockholders' tax brackets:

$$\frac{P_c - P_e}{D} = \frac{1 - t_d}{1 - t_g} \qquad (1.2)$$

Considering the assertion above, if a stock price decreases by more than a dividend amount on the ex-day, thus, resulting in a price-drop ratio (the left side of the equation 1.2) more than one, this should indicate that a marginal stockholder has a preferential tax treatment on distributable profit comparing to capital gains.

Although, at a first glance, Elton and Gruber's explanation of the ex-dividend day anomaly seems logical, almost a decade later the argument of the model was questioned. Brooks and Edwards (1980) claimed that tax neutral and non-preferentially taxed on capital gains market participants should enter the market and be capable of benefiting from the phenomenon, if transaction costs, they bear, are similar to marginal investor's ones. Among other possibilities the ex-dividend day price-drop ratio might also be affected by activity of arbitrage traders if potential premium is sufficient to cover transaction costs and losses from applicable tax rates (Ibid., 617). Another important remark of Brooks and Edwards is that positive relationship between dividend yield and price-drop ratio should not be attributed to the existence of tax clientele but may also imply that previously mentioned market participants enter the market (Ibid., 618), hereby pushing the price drop towards 1.

The idea about relevance of short-term traders and transaction costs was further expanded by Kalay (1982), who introduced a mathematical equation of no-profit bounds for arbitrageurs:

$$1-\frac{\alpha\overline{\mathrm{P}}}{\mathrm{D}} \le \frac{\mathrm{P_c}-\overline{\mathrm{P}}_\mathrm{e}}{\mathrm{D}} \le 1+\frac{\alpha\overline{\mathrm{P}}}{\mathrm{D}} \qquad (1.3)$$

with

$$\overline{\mathrm{P}}=\frac{\mathrm{P_c}+\overline{\mathrm{P}}_\mathrm{e}}{2}$$

where

$\alpha\overline{\mathrm{P}}$ − round trip transaction costs

D − dividend amount per stock

$\mathrm{P_c}$ − price on the day preceding ex-dividend day (further cum-dividend day)

$\overline{\mathrm{P}}_\mathrm{e}$ − expected price on ex-dividend day

If a price-drop (the middle part of the equation 1.3) is more (less) than one minus (plus) the transaction costs for a round trip short-term traders are facing, they will not enter the market as such trades will result in losses after accounting for fees. It is worth emphasizing that this holds only if short-term capital gains and dividends are taxed equally, which is supposed to be true for many markets. Thus, arbitrage activity is fully restricted by these no-profit frontiers (Ibid., 1062). However, Michaely and Vila (1995) argued that short-term trading around the ex-dividend day is defined not only by transaction costs but is also exposed to stocks’ risk. If risk associated with trading is high it would decrease trading volumes within the event window, as investors will adjust the capital, they are willing to commit accordingly (Ibid., 185).

The ex-dividend day anomaly started attracting more attention making researchers to seek for possible reasons that might stand behind such “imperfection”, paying more attention to how exchanges treat trading orders on this specific day. Dubofsky (1992) was the first to hypothesize that market microstructure, namely New York Stock Exchange (NYSE) Rule 118 and American Stock Exchange (AMEX) Rule 132, affects less liquid stocks that pay comparably small dividends. These rules imply that on the ex-dividend day all previously placed and not cancelled limit buy orders are decreased by the dividend amount, while leaving limit sell orders at the price initially recorded (Ibid., 33). Stocks with a price above 1$ were traded in multiples of 0.125$, so if adjusted price was not an integer number of eights, rounding to the nearest lower 0.125$ was implemented (Ibid., 34). These exchange specifics should lead to an increased gap between bid and ask quotes on the ex-day, both for high and low yielding stocks, but in case of high yielding stocks specialist will probably enter the market as dealers, thus, narrowing the spread (Ibid.,35).

The idea of microstructural explanation was further supported by Bali and Hite (1998). A price drop, approaching one with an increase of dividend yield, that was earlier attributed to the tax clientele effect, should be due to relatively small value of non-integer tick size comparing to a dividend per share (Ibid., 129). E.g., prices of two stocks with dividends of 0.36 and 0.86 euro per share and a tick size of 0.10 should be equally rounded down by 0.06 euro less than a cash distribution. Although, the 0.06 euro is common for both stocks, the price-drop ratio will amount to 0.83 and 0.93 respectively, approximating one for high yielding stock.

The most recent hypothesis was presented by French et al. (2005), who proposed that firm's leverage also influences how prices act on the ex-dividend day. As company value, which is represented not only by the stockholders' equity, but also by the value of the debt, decreases once profits are distributed, the risk of the security investors hold, on a contrary, increases. This increase in risk is partly born by creditors as cash distributed in the form of dividends will no longer be available. Thus, in the terms of unlevered firm a stock price would have fallen by the approximately dividend amount. However, the incomplete price adjustment is caused by a leverage that partially absorbed the risk. (Ibid.)

1.2. Empirical results of conducted studies

Since several reasons for stocks to behave in contrast to what it is assumed under market perfectness was presented, researchers commenced to complement their models and explore markets all around the world. Although, an enormous part of literature is dedicated to the ex-dividend day phenomenon, recent studies, in most, examined all proposed explanations for stock prices not to act as they are expected to, as long as an effect of structural changes in market microstructure and tax reforms. Further presented overview covers only some papers that pay an explicit attention to theorized anomaly drivers with a focus on most recent studies and countries with several distinctive features.

In regard to the topic, US stock exchanges have probably received the most attention. One of the latest and extensive researches was conducted by Mortal et al. (2017) on how NYSE and NASDAQ exchange microstructural differences and introduction of SuperMontage affected the ex-dividend day phenomenon. SuperMontage is NASDAQ trading platform that was introduced in 2002 and helped traders to execute transactions more efficiently. After its' launch a number of switchers from NASDAQ to NYSE decreased remarkably from on average 67 to 8 per annum. (Ibid., 1058). In total 291 companies moved to NYSE during 1983-2014, which led to an increase in the average price-drop of the movers from 51% to 87% (Ibid., 1061). Next, a matched sample of the two exchanges was created to determine the impact of SuperMontage's launch. Since 2003 price-drop ratio of the matched sample changed from 36% to 66% becoming very similar to NYSE's 68% and further confirming the relevance of market microstructure. (Ibid., 1066) The change in tick size from one-eight to decimalization in 2002 on both exchanges caused a 59% reduction of difference of price-drops between NYSE and NASDAQ (Ibid., 1074). As the introduction of the new system decreased the participants' transaction costs, the attenuated gap between exchanges also signalized of more favorable environment for arbitrageurs (Ibid., 1079).

While Mortal et al. work concerned short-term trading quite briefly, Blau et al. (2011) focused fully on short-selling activity, as one side of short-term trading. The introduction of SHO regulation in 2005 allowed to obtain data about shortened volumes, thus it became feasible to reveal which stocks were more attractive from the point of arbitrageurs. In their work Blau et al. analyzed NYSE dividend announcement and ex-days during 2005-2006 and detected unusually high short selling on and after the ex-dividend day especially for high yielding stocks (Ibid., 637).

Rantapuska (2008) had a unique opportunity to analyze trading pattern on the Finish stock market around the ex-dividend day at investors' level. So, it was possible to track if the dynamic tax clientele exists and which stocks are particularly targeted. The results were striking. Nonfinancial corporations and households were actively practicing dividend-capturing by buying stocks cum-dividend and selling ex-dividend, whereas foreign investors and mutual funds were selling stocks before the ex-dividend day and purchasing them back once the right for the cash distribution was transferred (Ibid., 364). However, after accounting for transaction costs, tax-exempt institutions and registered foreigners were able to extract higher than on average returns, while other two groups depended heavily on their ability to offset the losses (Ibid., 366). Consistent with previously mentioned study, high-yielding stocks were more likely to be engaged into short-term trading (Ibid., 373).

Along with the dividend yield, transaction costs play a crucial role for arbitrageurs. As costs vary between different types of market participants, it is common practice to use proxies in models to determine whether stocks' excess returns leave space for dividend capturing strategies (Henri and Koski 2017, 465). Henri and Koski through their access to Abel Noser Solutions database analyzed institutional investors' and investment managers' stock trading profitability around the ex-dividend day post real transaction costs (Ibid., 465). They documented abnormally high trading volumes of 8.6% during the period from five days prior to five days post the ex-dividend day. The activity increased with dividend yield and decreased with risk measures what is coherent with arbitrage strategies. (Ibid., 468) However, considering transaction costs, which are supposed to be low for such institutions, the ex-dividend day event window's average excess returns appeared to be negative (Ibid., 470). Still, there was an indication that some institutional investors that have certain trading skills can implement short-term trading profitably (Ibid., 491).

Akhmedov and Jakob (2010) analyzed the price drop on the Copenhagen stock exchange considering four possible taxation scenarios of capital gains and dividends. To be consistent with the tax clientele effect the price-drop ratio should have fallen within the range of 0.59-1.26. However, even after adjustment for market movements the close-to-close price ratio amounted to just 0.33, thus rejecting the hypothesis of taxes being able to explain the anomaly fully. (Ibid., 96) Disregarding detected abnormally high trading activity around the ex-dividend day neither tick size, nor short-term trading seemed to be relevant. As a result, illiquidity and absence of limit order adjustment were proposed as the main reasons for the phenomenon on the Copenhagen stock exchange. (Ibid., 103)

Haesner and Schanz (2013) examined how the Germany tax reform of 2001 affected the ex-dividend day price-drop. The reform eliminated the possibility to use tax credits and made various types of investors to be indifferent between capital gains and dividends. Authors found evidence of weakening tax-induced clientele effect since 2001 along with signs of short-term trading. (Ibid.)

United Arabic Emirates (UAE) is an example of a country, where there are neither taxes on capital gains nor on dividends. Such environments are valuable as they reduce the number of possible phenomenon determinants. In spite of Dupuis (2019) expecting stock prices to drop by the dividend amount, an average price-drop approximating just 0.66 was documented. Another distinctive feature of UAE is that with a free float around 63% major stockholders, such as families, corporations and government, do not actively trade, thus the impact of illiquidity was taken into consideration (Ibid., 245). The results state that excess returns on UAE exchanges enhance with the yield and diminish with an increase in liquidity and trading volumes. Still, while transaction costs have a minor impact on a price drop, risk turned out to be insignificant (Ibid.,249).

Along with United Arabic Emirates, the Athens Stock Exchange has quite many unique features: dividends and capital gains are not taxed, companies are obliged to distribute profits each year, transaction costs are fixed at a maximum rate of 1%, prices are decimalized, the tick size compared to the dividend is negligible, there are only few market makers, and there is no limit order adjustment. Moreover, since the first quarter of 2001 opening prices on the ex-dividend date were no longer decreased by the dividend amount (Asimakopoulos et al. 2015, 2-3). After this change the price-drop slightly increased, but remained around 0.6 (Ibid., 5). Asimakopoulos et al. also proposed that illiquidity, is the main factor that causes stock prices to not adjust fully (Ibid., 11).

Mexican market is an example of markets for which none of the theories found confirmation. After accounting for differences in taxation, existence of tax credit for domestic individual investors, market microstructural impediments and dividend inconvenience theory Kadapakkam and Martinez (2008) concluded that the “ex-day returns in Mexico are a puzzle”.

While the ex-dividend day peculiarity incited various researchers to “rack their brains”, the Baltic states amount for only a couple studies that touched on the topic. The first was conducted by Sander (2007) who focused on the trading activity of 50 cash distribution events around the ex-dividend day window in the Estonian stock market during 2000-2006. Results detected unusual trading volumes for two days preceding the ex-dividend day, on the ex-day and during four days after the ex-day (Ibid., 26). For 17 out of the 50 events short-term trading was profitable, especially given the fact that investors were engaging brokers significantly less than during the rest of the year, thus reducing accompanying costs (Ibid., 18-19). After the analysis of short-term ownership structural changes, Sander inferred that observed abnormally high trading volumes were caused by foreign investors that implement dividend avoidance strategies (Ibid., 32).

The second work on the Baltic States was conducted by Uustalu (2010) and comprised the ex-dividend day stock prices behavior in the Baltic countries during 2000-2010. For Estonia, Latvia, and Lithuania the average market-adjusted price-drop ratios were 0.88, 0.47 and 0.52 respectively when extreme observations were removed. Although in the Estonian stock market a price drop was less than one, the difference was not statistically significant from one. Considering all three countries, a sign of tax clientele was detected only on Tallinn Stock exchange. Arbitrage activity and tick size appeared to be not responsible for Latvian and Lithuanian stocks to drop by half less than the distributed cash dividend. (Ibid.)

1.3. An overview of Nasdaq Baltic exchanges and their trading trends

The first stock exchange in the Baltic states was established in 1992 in Lithuania (VSE). Subsequently, Riga (RSE) and Tallinn (TSE) stock exchanges were founded in 1993 and 1995 respectively. All three markets operated fully independently until 2001, when Helsinki Stock Exchange (HEX) became a major stockholder of TSE. Next year it also acquired a controlling share of RSE. Later, as a result of a merger, in 2003 HEX and futures stock exchange OM formed OMHEX, which was further renamed as OMX after acquisition of VSE in 2004. (NASDAQ OMX Nordic) Starting from the same year trading at TSE and RSE and from 2005 at VSE was transferred to the SAXESS, a common trading platform which the Nordic markets had been using since 2000. New system allowed to reduce administrative and operating costs of exchanges, enabling users to track the markets' situation in real time and fulfil orders more quickly. (Guide to Baltic market 2004-2005)

Another important event took place in 2008, and that was an establishment of NASDAQ OMX Group via the merger of NASDAQ and OMX. The synergy allowed to reduce transaction fees by 10 to 40 percent (Guide to NASDAQ OMX Baltic Securities Market 2008). As the number of transactions was increasing, the necessity for technical solution to be more precise and powerful became obvious (Figure 2.1.). In 2011 SAXESS trading system was fully replaced by Genium INET that is used until nowadays (Guide to the Baltic market 2011).

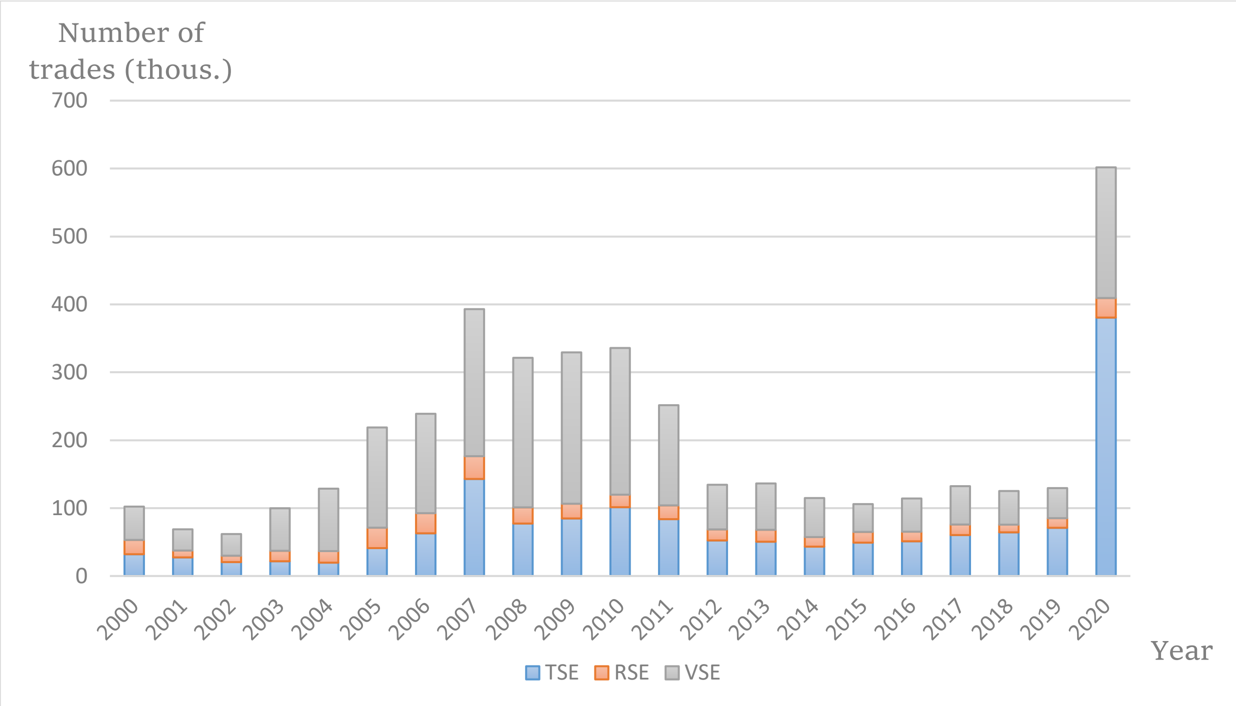

Figure 2.1. Number of stock trades per year of companies listed in NASDAQ Baltic Main and Secondary list during 2000-2020
Source: Nasdaq Baltic webpage; author's calculations

In terms of trends, the market capitalization (cap) of Baltic Joint market reached its maximum of almost 13.7 billion euros in 2007 (Figure 2.2.). However, the impact of the global financial crisis affecting economies all around the world was more severe in the Baltic states, due to their dependence on foreign investment inflows, e.g., in 2009 the gross domestic product growth rates were -13.89% in Estonia, -17.95% in Latvia and -14.74% in Lithuania, whereas the EU average was just -4.25% (Nikkinen et al. 2012, 401-402). Even a decade after the economic recession of 2008 the pre-crisis level of market cap has still not been achieved.

Despite the fact that all three Baltic exchanges were established almost at the same time, differences between stock market caps are noticeable. Among neighbors Latvia has always been the smallest, amounting to a maximum 21% share of the Baltic stocks' total market cap in 2015. In 2004 Lithuanian and Estonian shares of joint Baltic market were 44% each. While Latvian and Lithuanian market capitalizations increased in 2005 by 60% and 55% respectively in relation to the preceding year, the Estonia share remained at the same level due to the delisting of

Hansapank which fraction amounted to almost 67% of Estonian total market cap by the end of 2004.

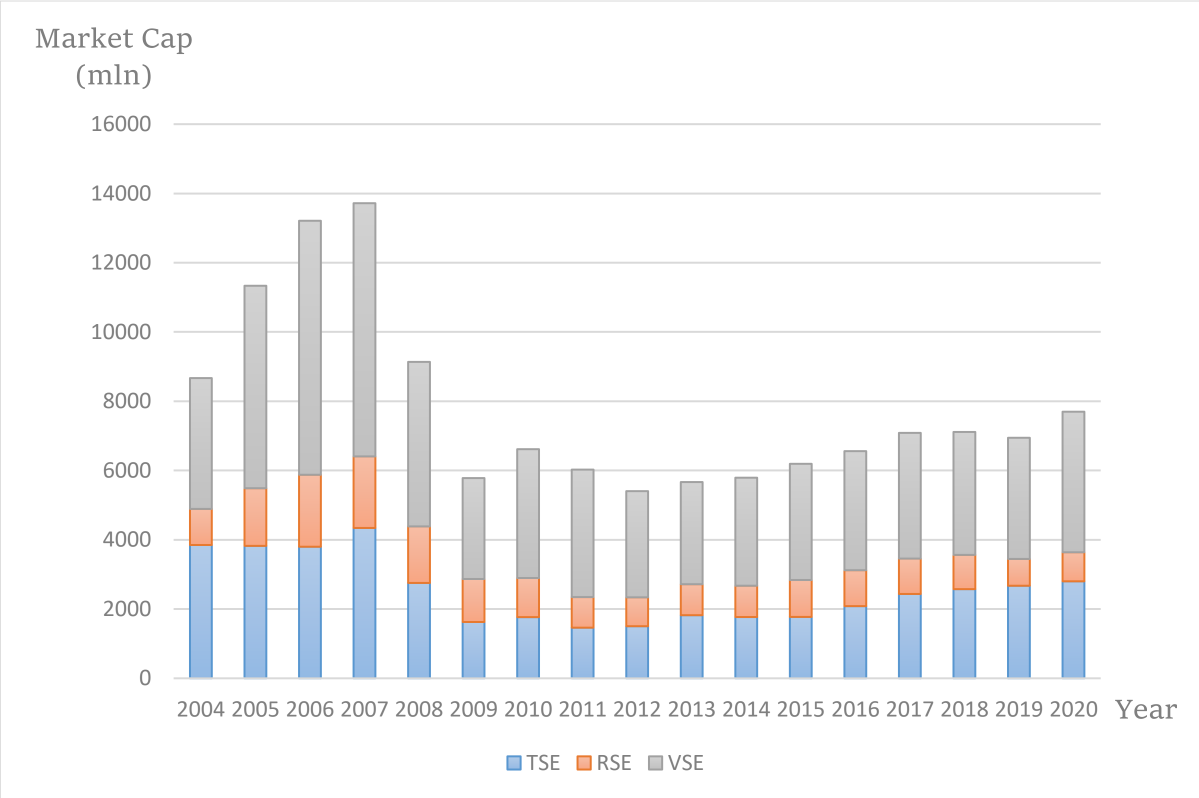

Figure 2.2. Average yearly stock market capitalization breakdown by country during 2004-2020
Source: Nasdaq Baltic webpage; author's calculations

Figure 2.3. exhibits trends of stocks' trading volumes. Affected by the global financial crisis those reached the bottom in 2014 and remained at relatively flat level until 2020, when trading activity on TSE and VSE almost doubled. At the first glance, such increases in trading activity may be attributed to the COVID-19 pandemic and sophisticated investors trying to benefit from the situation by buying undervalued stocks. However, taking into consideration skyrocketed number of trades (Figure 2.1.) with comparatively low increase in turnover (see Figure 2.4.) the impact of such significant market makers, like Swedbank and LHV Pank setting transaction fees for trading Baltic stocks to 0 by the end of 2019 and the beginning of 2020 respectively may not be ignored.

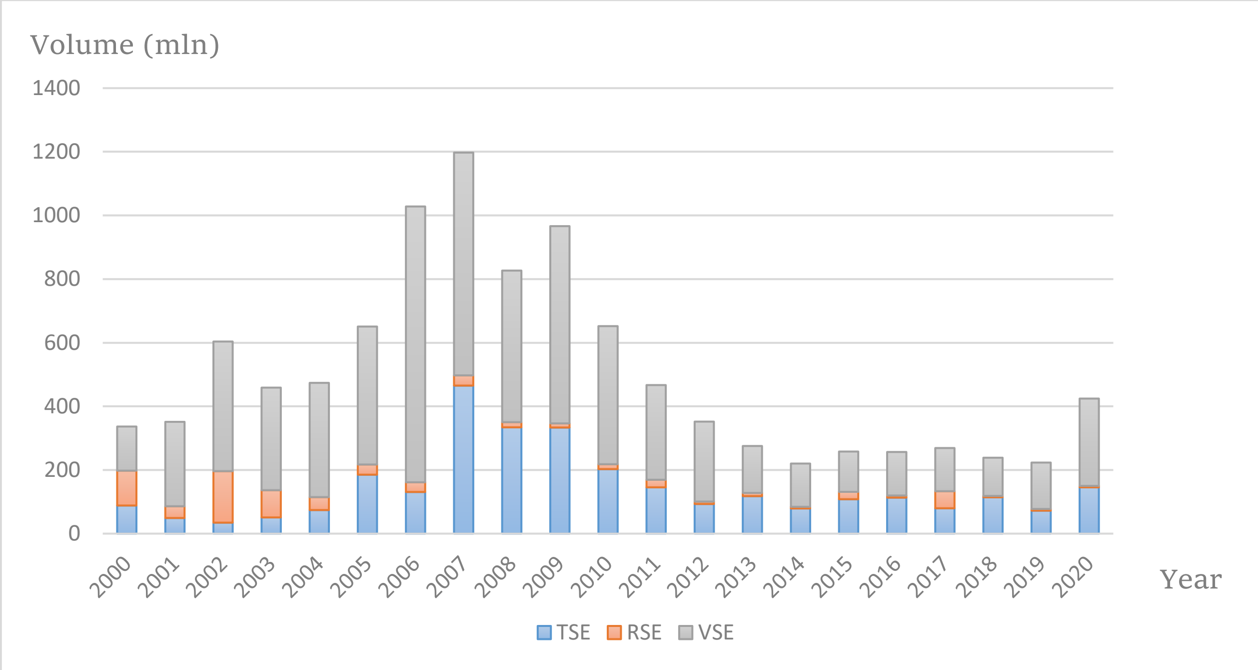

Figure 2.3. Yearly trading volumes of companies listed in NASDAQ Baltic Main and Secondary list 2000-2020
Source Nasdaq Baltic webpage; author's calculations

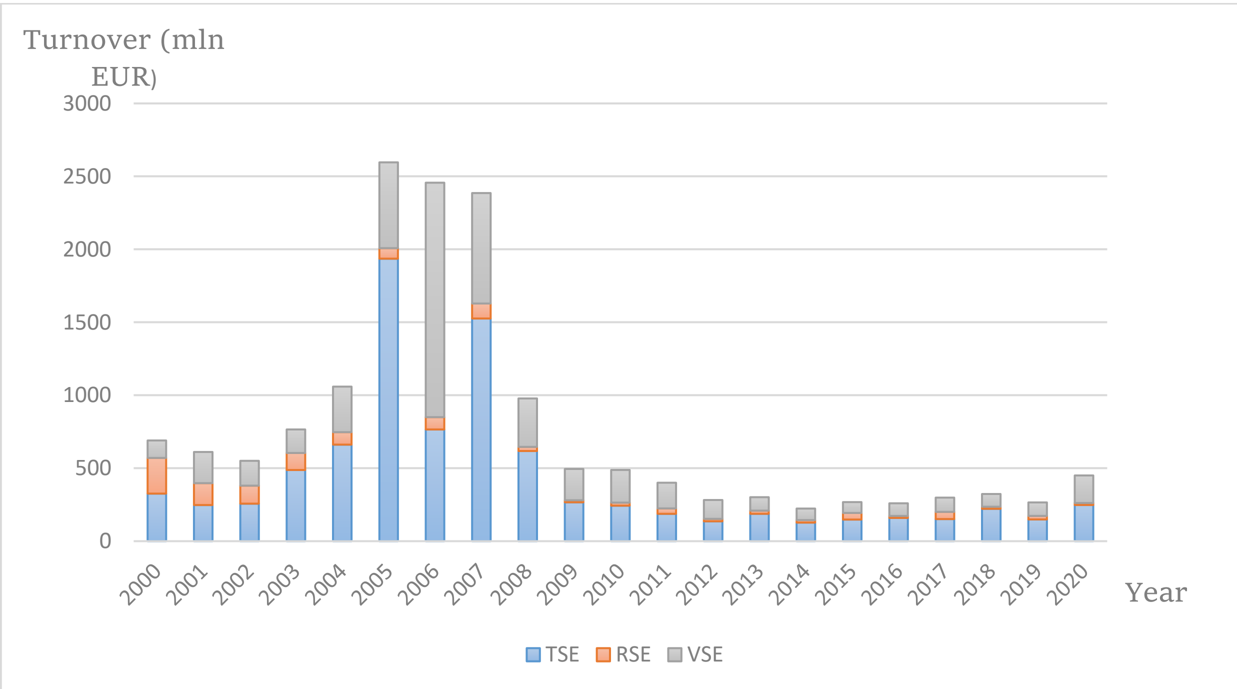

Figure 2.4. Yearly turnover of companies listed in NASDAQ Baltic Main and Secondary list
Source: Nasdaq Baltic webpage; author's calculations

In spite of Lithuanian stock market overtaking Latvia and Estonia from the point of market capitalisation, the trading volumes and, in most years, the number of transactions, it is worth noticing that on average TSE stocks are more liquid (see Figure 2.5).

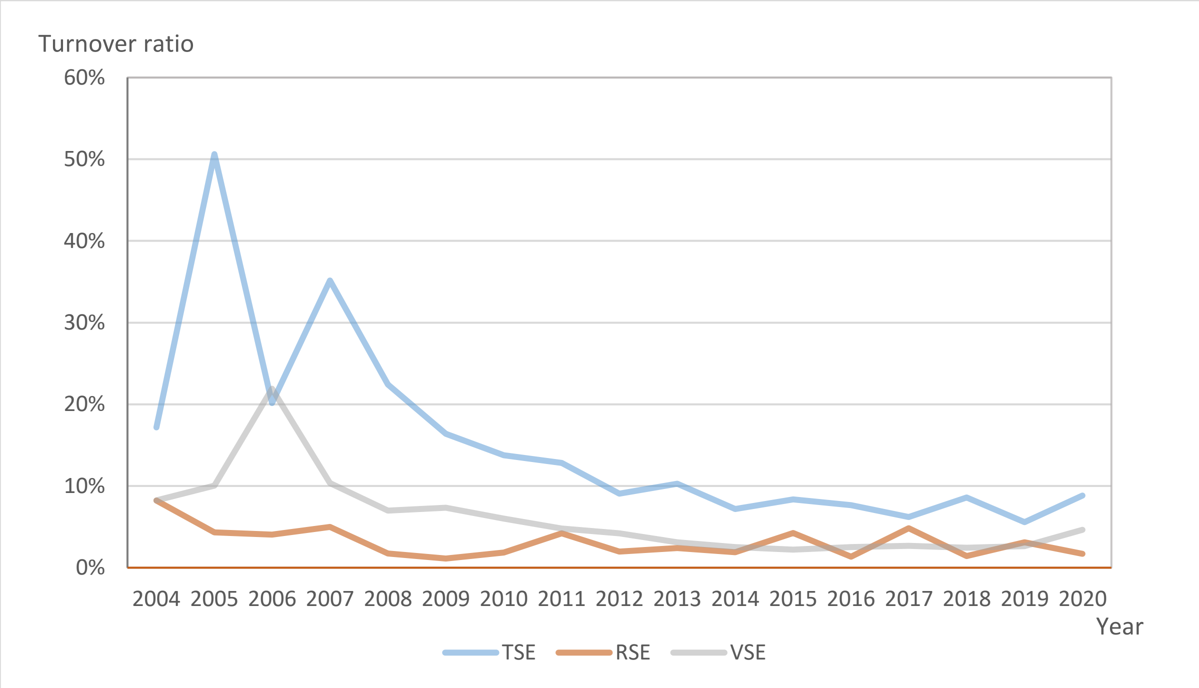

Figure 2.5. Turnover ratio of NASDAQ Baltic Exchanges
Source: Nasdaq Baltic webpage; author's calculations

A sharp decline in 2006 TSE stocks' liquidity should not be considered at such extreme extent. The pattern is fully driven by the previously mentioned delisting of Hansapank in the middle of 2005 with its' large share of TSE total market capitalization.

1.4. Taxation of capital gains and dividends in the Baltic states

Capital gains of Estonian corporations were subject to taxation throughout the 2000-2020 only upon distribution of profits at an effective income taxes rate presented in table 2.1. However, starting from 2019, if a company pays dividends regularly, a reduced corporate income tax (CIT) of 17.5% is applied. Losses incurred as a result of securities' alienation cannot be transferred. At the same time dividends received by resident corporations from other companies that have already been taxed or in which Estonian company's holdings amount to the required share (20%

from 2000 to 2006, 15% during 2007-2008, 10% since 2009) were tax-exempt, thus double taxation was avoided.

Table 2.1. Tax rates on capital gains and dividend in Estonia during 2000-2020

Year	Resident corporations		Resident individuals		Non-resident corporations		Non-resident individuals	
	Capital gains	Dividends	Capital gains	Dividend	Capital gains	Dividend	Capital gains	Dividend
2000	35.14%	0% / 35.14%	26%	0% / 26%	0%	0% / 26%	0%	26%
2001	35.14%	0% / 35.14%	26%	0% / 26%	0%	0% / 26%	0%	26%
2002	35.14%	0% / 35.14%	26%	0% / 26%	0%	0% / 26%	0%	26%
2003	35.14%	0% / 35.14%	26%	0% / 26%	0%	0% / 26%	0%	26%
2004	35.14%	0% / 35.14%	26%	0% / 26%	0%	0% / 26%	0%	0%
2005	31.58%	0% / 31.58%	24%	0% / 24%	0%	0% / 24%	0%	0%
2006	29.87%	0% / 29.87%	23%	0% / 23%	0%	0% / 23%	0%	0%
2007	28.21%	0% / 28.21%	22%	0% / 22%	0%	0% / 22%	0%	0%
2008	26.58%	0% / 26.58%	21%	0% / 21%	0%	0% / 21%	0%	0%
2009	26.58%	0% / 26.58%	21%	0% / 21%	0%	0%	0%	0%
2010	26.58%	0% / 26.58%	21%	0% / 21%	0%	0%	0%	0%
2011	26.58%	0% / 26.58%	21%	0% / 21%	0%	0%	0%	0%
2012	26.58%	0% / 26.58%	21%	0% / 21%	0%	0%	0%	0%
2013	26.58%	0% / 26.58%	21%	0% / 21%	0%	0%	0%	0%
2014	26.58%	0% / 26.58%	21%	0% / 21%	0%	0%	0%	0%
2015	25.00%	0% / 25.00%	20%	0% / 20%	0%	0%	0%	0%
2016	25.00%	0% / 25.00%	20%	0% / 20%	0%	0%	0%	0%
2017	25.00%	0% / 25.00%	20%	0% / 20%	0%	0%	0%	0%
2018	25.00%	0% / 25.00%	20%	0% / 20%	0%	0%	0%	0%
2019	25.00% / 17.50%	0% / 25.00% / 17.50%	20%	0% / 20% / 7%	0%	0%	0%	0%
2020	25.00% / 17.50%	0% / 25.00% / 17.50%	20%	0% / 20% / 7%	0%	0%	0%	0%

Source: Tulumaksuseadus: compiled by the author

Realized capital losses from disposal of financial assets of Estonian resident individuals were carried forward indefinitely and used to cover capital gains. However, starting from 2006 losses incurred from stocks that were purchased within 30 days before they went ex-dividend and sold within 30 days after they went cum-dividend could not be used to reduce the taxable base. Another major addition to the Tax Law was related to investment accounts. Since 2011 resident individuals can defer taxation of capital gains until the money are withdrawn from such. Once total annual income exceeded the allowed non-taxable minimum, resident individuals were subjects to the nominal tax rates presented in table 2.1. Similarly, to domestic corporations Estonian individuals had to pay personal income tax (PIT) only if dividends' paying company did not withheld CIT on distributable profits. However, starting from 2019 if dividends were taxed at the reduced nominal rate of 17.5%, then an individual receiving the payment must pay 7% PIT.

A foreign individual was a subject to a nominal tax rate of 26% on dividend income just during 2000-2003, while non-resident corporation without permanent establishment were released from such obligation only starting from 2009. Although, dividends received by a foreign corporation from a domestic company were taxed at the nominal tax rate, it was possible to avoid CIT if a non-resident was not registered in a low-tax territory and its' share of Estonian corporation amounted to at least 25% during 2000-2004. The required minimum holding was reduced to 20% in 2004 and further to 15% during 2007-2008. Non-resident individuals and corporation were not taxed on capital gains.

In 2000 Latvian corporations had to pay taxes on capital gains at a flat rate of 25% (see Table 2.2). Starting from 2001 and until 2006 profits and losses arose from the sale of publicly circulated securities were tax exempt. Since 2007 this rule applied to securities within European Union (EU) and European Economic Area (EEA). However, from 2011 and onwards all proceeds from stocks were not taxed. Throughout 2000-2008 losses from alienation of securities other than tax-exempt could be caried forward for 5 subsequent years only if securities were not traded more than once per year and the criterion of a minimum holding period of 12 months is met. The number of years was extended to 8 during 2009-2011. Starting from 2012 such losses could be deducted only from the taxable income in the same period if a targeted company is not a resident in a low-tax or tax-exempt area. In 2018 under a major tax reform Latvian introduced a tax regime quite like the one Estonia had. Starting from 2018 CIT was paid only if profits are distributed at effective tax rate of 25%. The tax relief is now applied to capital gains from disposal of stock held more than 36 months. Tax losses accumulated before the tax reform, can be used to cover a maximum of 50% of taxes payable upon distribution of profits during the period up to 2022.

Dividends received by a domestic corporation from another resident company were not taxed if there was no tax relief applicable to the dividend payer. At the same time, during 2000-2004 dividends received from a non-resident were not taxed only if a domestic corporation owned at least 25% of the dividend-paying company and a foreign company was not recognized as resident of low-tax or tax-free zone. In addition, during 2005-2006 dividends received from a company of EU in which it owned not less than 10% were tax free. This minimum holding rule was eliminated in 2007, i.e. dividends received from all EU and EEA were tax exempt. Starting from 2012 and until 2017 dividend received from a foreign corporation, unless it was not a resident of a low-tax or tax-exempt territory, was not supposed to be accounted for CIT. Otherwise a 20% flat tax rate applied. Starting from 2018 received dividend income is also taxed only upon distribution. However, tax base may be reduced by the tax amount that has already been withheld from the received dividends if there were no tax relief and the residency criteria are met. In the case where a maximum deductible amount exceeds the tax on distributable profit, it may be carried forward.

Table 2.2. Tax rates on capital gains and dividend in Latvia during 2000-2020

Year	Resident corporations		Resident individuals		Non-resident corporations		Non-resident individuals	
	Capital gains	Dividends	Capital gains	Dividend	Capital gains	Dividend	Capital gains	Dividend
2000	25.00%	0% / 25%	0% / 25%	0% / 25%	0%	10%	0%	10%
2001	0%	0% / 25%	0% / 25%	0% / 25%	0%	10%	0%	10%
2002	0%	0% / 22%	0%	0% / 25%	0%	10%	0%	10%
2003	0%	0% / 19%	0%	0% / 25%	0%	10%	0%	10%
2004	0%	0% / 15%	0%	0% / 25%	0%	0% / 10%	0%	10%
2005	0%	0% / 15%	0%	0% / 25%	0%	0% / 10%	0%	10%
2006	0%	0% / 15%	0%	0% / 25%	0%	0% / 10%	0%	10%
2007	0%	0% / 15%	0%	0% / 25%	0%	0% / 10%	0%	10%
2008	0%	0% / 15%	0%	0% / 25%	0%	0% / 10%	0%	10%
2009	0%	0% / 15%	0%	0% / 23%	0%	0% / 10%	0%	0% / 10%
2010	0%	0% / 15%	15%	10%	0%	0% / 10%	0%	10%
2011	0%	0% / 15%	15%	10%	0%	0% / 10%	0%	10%
2012	0%	0% / 15%	15%	10%	0%	0% / 10%	0%	10%
2013	0%	0% / 15%	15%	10%	0%	0% / 15%	0%	10%
2014	0%	0% / 15%	15%	10%	0%	0% / 15%	0%	10%
2015	0%	0% / 15%	15%	10%	0%	0% / 15%	0%	10%
2016	0%	0% / 15%	15%	10%	0%	0% / 15%	0%	10%
2017	0%	0% / 15%	15%	10%	0%	0% / 15%	0%	10%
2018	25.00%	0% / 20%	20%	0% / 10%	0%	0% / 20%	0%	0% / 10%
2019	25.00%	0% / 20%	20%	0% / 10%	0%	0% / 20%	0%	0% / 10%
2020	25.00%	0% / 20%	20%	0% / 10%	0%	0% / 20%	0%	0% / 10%

Source: Likumi.lv webpage; compiled by the author

During 2000-2001 domestic individuals were subject to a flat tax rate of 25% on capital gains obtained from the disposal of securities held less than 12 months. Starting from 2002 and up to 2009 capital gains were not taxed irrespectively of the holding period. Although, as from 2010 capital gains were a subject to a flat rate of 15% (20% starting from 2018) losses incurred from the disposal of assets during the year were allowed to be covered from the same year capital gains. Any carry-forward of excess losses was restricted. Over 2000-2003 resident individuals didn't have to pay taxes on dividends received from domestic corporation if no tax relief applied to the payer. Since 2004 tax exemption was also applicable to dividends received from residents of EU and further as of 2006 to EEA countries. However, from 2010 and until 2017 resident individuals were a subject to an income tax on dividends at a flat rate of 10%. After a tax reform of 2018, if CIT has been withheld in Latvia or abroad, dividends received by a domestic individual were no longer taxed.

Neither non-resident corporations nor foreign individuals should pay taxes on capital gains. However, if the latter's total assets comprised at least 50% of real estate located in Latvia which was owned directly or indirectly, disposal of such will trigger an income tax applicable to capital gains. Non-resident corporations were taxed at a 10% flat rate on dividends during 2000-2010. However, starting from 2004 if a non-resident corporation was a member of EU (from 2007 also EEA) and held at least 25% of Latvian domestic corporation during the preceding 2 years, no CIT on dividends were withdrawn. The minimum holding restriction was decreased to 10% in 2005 and fully dismissed as of 2008. Starting from 2013 dividends received by non-resident corporations are tax exempt if payer's residency was not in a low-tax or tax-exempt area.

Non-resident individuals were taxed at 10% on dividend income in the most years. However, in 2009 if a foreign individual was a resident of another EU or EEA country, dividends received from Latvian domestic corporations were not taxed, unless CIT were not applied to the paying company. Starting from 2010 and up to 2017 again a 10% flat tax rate was applied. Since 2018 taxation of dividend of non-resident individuals was like for resident individuals.

The corporate income tax Law of Lithuania was adopted in December 2001, thus the provisional Law was used in years prior to it. Domestic corporations were taxed on capital gains at a flat rate 24% (see Table 2.3.) during 2000-2001, which was further reduced to 15%. However, starting from 2007 it became possible to avoid tax once profits are realized from disposal of shares of a EEA company or a company with an ownership of least 25% during preceding 2 years, if a double taxation agreement with a country of residence was signed. Starting from 2018 the minimum required holding was reduced to 10%. The losses were allowed to be carried forward for 3 years during 2002-2007, while the period was extended to 5 years from 2008.

Dividends received by a domestic corporation were taxed at a flat rate of 29% during 2000-2001. Starting from 2002 if a dividend payee possessed at least 10% of another domestic company, which profits were distributed during last 12 months, no CIT had to be paid. The same rule was applied to dividends received from a foreign corporation if it was not situated in the targeted area. Yet, starting from 2009 dividends received from all EEA companies were tax exempt. Otherwise, a tax rate of 15% during 2002-2008, 20% in 2009 and 15% starting from 2010 year had to be paid.

Table 2.3. Tax rates on capital gains and dividend in Lithuania during 2000-2020

Year	Resident corporations		Resident individuals		Non-resident corporations		Non-resident individuals	
	Capital gains	Dividends	Capital gains	Dividend	Capital gains	Dividend	Capital gains	Dividend
2000	24%	29%	0% / 15%	29%	0%	29%	0%	29%
2001	24%	29%	0%	29%	0%	29%	0%	29%
2002	15%	0% / 15%	0%	29%	0%	0% / 15%	0%	29%
2003	15%	0% / 15%	0% / 15%	15% / 33%	0%	0% / 15%	0%	15%
2004	15%	0% / 15%	0% / 15%	15% / 33%	0%	0% / 15%	0%	15%
2005	15%	0% / 15%	0% / 15%	15% / 33%	0%	0% / 15%	0%	15%
2006	15%	0% / 15%	0% / 15%	15% / 27%	0%	0% / 15%	0%	15%
2007	0% / 15%	0% / 15%	0% / 15%	15% / 27%	0%	0% / 15%	0%	15%
2008	0% / 15%	0% / 15%	0% / 15%	15% / 24%	0%	0% / 15%	0%	15%
2009	0% / 20%	0% / 20%	0% / 15%	20%	0%	0% / 20%	0%	20%
2010	0% / 15%	0% / 15%	0% / 15%	20%	0%	0% / 15%	0%	20%
2011	0% / 15%	0% / 15%	0% / 15%	20%	0%	0% / 15%	0%	20%
2012	0% / 15%	0% / 15%	0% / 15%	20%	0%	0% / 15%	0%	20%
2013	0% / 15%	0% / 15%	0% / 15%	20%	0%	0% / 15%	0%	20%
2014	0% / 15%	0% / 15%	0% / 15%	15%	0%	0% / 15%	0%	15%
2015	0% / 15%	0% / 15%	0% / 15%	15%	0%	0% / 15%	0%	15%
2016	0% / 15%	0% / 15%	0% / 15%	15%	0%	0% / 15%	0%	15%
2017	0% / 15%	0% / 15%	0% / 15%	15%	0%	0% / 15%	0%	15%
2018	0% / 15%	0% / 15%	0% / 15%	15%	0%	0% / 15%	0%	15%
2019	0% / 15%	0% / 15%	0% / 15% / 20%	15%	0%	0% / 15%	0%	15%
2020	0% / 15%	0% / 15%	0% / 15% / 20%	15%	0%	0% / 15%	0%	15%

Source: Teises aktu registras; compiled by the author

Personal income tax law of Lithuania was adopted in July 2002. According to the provisional Tax Law in 2000 capital gains that exceeded 12 basic non-taxable minimums (400-690 euros dependent on such resident features, like number of children, occupation etc.) at 15% tax rate, while losses could be carried to the next year. Since 2001 and further on no losses could be carried forward. During 2001-2002 income from the sale of securities was not taxed. Starting from 2003 and until 2014 capital gains were tax-exempt if disposed securities were owned not less than 366 days and individuals' share in the dividend-paying company did not exceed 10% during preceding 3 years. Also, no PIT was applied to proceeds from the transaction of securities purchased before 1999. In 2014 and in 2015 capital gains that did not surpass 2 880 euros and 3 000 euros respectively were tax-exempt. During 2016-2020 the limit was decreased dramatically to 500 EUR. Otherwise a tax rate of 15% was applied throughout 2003-2018. Staring from 2019 if annual amount of capital gains was within 500-162 300 euros a 15% flat rate was applied. The amount over 162,300 euros is taxed at 20%.

During 2000-2002 dividends received by a domestic individual were taxed at 29%. Later dividends that were paid by Latvian corporation or members of EEA were a subject to 15% during 2003-2008, otherwise a 33% tax rate applied 2003-2005; 27% during 2006-2007; 24% in 2008. Over 2009-2013 a flat tax rate of 20% was applied to dividends received. Starting from 2014 the rate was reduced to 15%.

Non-resident corporations were taxed on dividend income very similarly to resident corporations. During 2000-2001 a 29% tax rate applied to dividends received. If a non-resident corporation held at least 10% of domestic company during last 12 months no tax was paid on the received dividend throughout 2002-2020. If a minimum holding requirement was not met, a 15% tax was applied during 2002-2008; 20% in 2009 and 15% since 2010 and until now. Non-resident individuals receiving dividends from Lithuania corporations were subject to 29% tax during 2000-2002; 15% during 2003-2008, which was increased to 20% during 2009-2013, and reduced back to 15% in 2014-2020. Neither non-resident corporations nor individuals were taxed on capital gains.

2. DATA AND METHODOLOGY

2.1. Data

The thesis focuses on the stocks included in the main and secondary lists of three Baltic stock exchanges (TSE, RSE and VSE) that paid dividends during the years 2000-2020. The period was chosen since it covers an economic boom, the recession of 2007Q3-2009Q4, and the post-crisis recovery, thus providing a valuable opportunity to check for structural changes in stocks' price behavior on the ex-dividend days.

Information about the ex-dividend days, payout amounts, daily prices and trading volumes was initially extracted from the Thompson Reuters Eikon database and Nasdaq Baltic webpage. However, significant discrepancies were discovered in some stock prices' historical quotes after verification, thus only the latter's data was used in the analysis. Financial figures for the calculation of accounting ratios were obtained directly from companies' financial statements published on Nasdaq Baltic webpage.

As historical prices are quoted in euros whereas dividend amounts paid out during 2000-2013 of RSE and 2006-2009 of VSE stocks were stated in Latvian lats and Lithuanian litas respectively, fixed foreign exchange rates applied[1]. The dividend history for 2000-2005 of VSE stocks was not available, including from Nasdaq, the data for the period was taken from Uustalu (2010).

Following the literature exchange traded funds and investments companies were not considered. Also, below stated common requirements were applied to stocks to be included into the final sample:

1) dividends are distributed regularly;
2) only ordinary cash dividend payments are considered;
3) no other payouts from the same company around the ex-dividend day;

[1] LVL/EUR= 0.702804
LTL/EUR=3.4528

4) a distributable amount equals to at least 0.01 euro;
5) information about prices on the ex-dividend day and the last cum-dividend day, as long as trading volumes is available;
6) adequate daily price changes during the benchmark period of 45 to 6 days around the ex-dividend day and the event window of 10 days surrounding the ex-dividend day;
7) a stock must be traded on the ex-dividend day and minimum on 40 days during the benchmark period;
8) financial institutions are not included, as dissimilar accounting ratios are calculated for such companies;
9) financial figures for two financial years preceding the ex-dividend day are available.

The justification for such limitations is that if profits are not distributed regularly, then there is no base for attracting clientele targeting specific dividend policies. As long as extraordinary payouts may not be anticipated, thus a stock price reaction on such might be contradictory. The reason for eliminating dividend payments which had other distributions around the ex-dividend days is to preclude the noise effect on stock price behavior on the day the thesis focuses. A stock is required to be traded on the ex-day, otherwise it will result in a zero price change. As insignificant payouts bias price-drop ratios away from the expected value, the minimum amount is set to 0.01 euro. Appendix 1. contains detailed information about number of stocks not meeting the criteria.

TSE initial sample consisted of 195 events. After employing limitations, the final sample for the analysis of a possible impact financials have on a stock price behavior during ex-days comprised 144 observations. Table 3.2. summarizes the samples characteristics for TSE stocks.

RSE full sample contained 180 dividend ex-day events, however 63 observations left that meet all criteria. More than one third of observations were eliminated due to a security not being traded on the ex-dividend day, which would result in a zero price change between the cum-dividend and ex-dividend days. Table 3.3. summarizes the samples characteristics for RSE stocks.

Table 3.2. Descriptive statistic of TSE sample during 2000-2020

N=144					
Variable	Mean	Median	SD	Maximum	Minimum
Dividend amount (EUR)	0.30	0.19	0.3070	1.60	0.01
Dividend yield (%)	4.93	4.92	2.8252	16.37	0.72
Cum-day price (EUR)	5.50	4.33	4.3787	21.93	0.62
Ex-day price (EUR)	5.21	3.94	4.1688	21.55	0.60
Market cap (thous. EUR)	224,152	105,590	286,620	1,667,040	6,596
Firm's risk (FRISK	0.02	0.01	0.0076	0.04	0.01
Active risk	0.02	0.02	0.0089	0.05	0.01
Average abnormal volumes	7.18	0.62	17.5337	128.75	-0.84
Ex-dividend trading volumes	154,598	17,672	385,406.6	2,313,624	50
Price-drop ratio	0.89	0.98	1.1051	6.00	-5.33
Abnormal returns	0.00	0.00	0.0235	0.08	-0.07
EPS (EUR)	0.45	0.40	0.4144	2.13	-0.31
ROE	0.17	0.15	0.1336	0.57	-0.31
ROA	0.11	0.09	0.0926	0.46	-0.12
P/B	2.03	1.56	1.5090	12.58	0.42
P/E	17.87	12.35	37.5927	361.58	-69.74
D/E	0.40	0.29	0.4094	1.66	0
D/A	0.18	0.17	0.1698	0.56	0
Illiquidity ratio	240.78	66.30	689.4283	6,191.14	0.13

Source: compiled by the author

Table 3.3. Descriptive statistic of RSE sample during 2000-2020

N=63					
Variable	Mean	Median	SD	Maximum	Minimum
Dividend amount (EUR)	0.31	0.21	0.3041	1.28	0.01
Dividend yield (%)	4.69	3.38	4.3675	28.75	0.33
Cum-day price (EUR)	6.44	6.84	4.1542	16.65	0.63
Ex-day price (EUR)	6.26	6.70	4.0526	16.58	0.63
Market cap (thous. EUR)	156,926	80,514	166,090	579,080	3,381
Firm's risk	0.02	0.02	0.0088	0.04	0.01
Active risk	0.03	0.02	0.0097	0.05	0.01
Average abnormal volumes	0.04	-0.20	0.7160	2.13	-0.95
Ex-dividend trading volumes	4,061	1,900	8,667	50,230	3.00
Price-drop ratio	0.55	0.65	1.0701	3.75	-3.04
Abnormal returns	0.01	0.01	0.0275	0.12	-0.04
EPS (EUR)	0.50	0.48	0.4984	2.24	-1.02
ROE	0.09	0.08	0.0741	0.31	-0.17
ROA	0.06	0.05	0.0556	0.21	-0.15
P/B	1.23	1.09	0.7454	4.20	0.36
P/E	14.50	12.51	12.9429	71.48	-26.38
D/E	0.20	0.10	0.3140	1.65	0
D/A	0.10	0.07	0.1286	0.46	0
Illiquidity ratio	18,170.28	317.77	112,908	895,555	1.69

Source: compiled by the author

VSE initial sample contained 304 ex-days, however 193 payouts left for the analysis. The majority of observations was eliminated because of a negligible size of a dividend. Table 3.4. summarizes the samples characteristics for RSE stocks. Detailed information about stocks not meeting the restrictions is stated in Appendix 1.

Table 3.4. Descriptive statistic of VSE sample during 2000-2020

N=193					
Variable	Mean	Median	SD	Maximum	Minimum
Dividend amount (EUR)	0.46	0.06	3.5662	48.34	0.01
Dividend yield (%)	5.23	4.17	4.3495	33.79	0.36
Cum-day price (EUR)	5.54	1.38	21.7089	228.8	0.16
Ex-day price (EUR)	5.25	1.32	19.9021	200.13	0.16
Market cap (thous. EUR)	220,969	98,364	255,499	1,773,978	4,574
Firm's risk (FRISK	0.02	0.02	0.0075	0.04	0
Active risk	0.02	0.02	0.0085	0.05	0.01
Average abnormal volumes	0.31	-0.06	1.7121	14.58	-0.98
Ex-dividend trading volumes	42,459	7,771	124,318	1,209,132	9
Price-drop ratio	0.53	0.63	1.054	8.68	-3.62
Abnormal returns	0.02	0.02	0.0283	0.18	-0.06
EPS (EUR)	0.23	0.1	0.6158	5.24	-0.64
ROE	0.13	0.13	0.1219	0.81	-0.39
ROA	0.07	0.07	0.0688	0.47	-0.26
P/B	1.12	0.65	1.7848	20.95	0.08
P/E	20.78	12.75	38.4131	284.9	-69.06
D/E	0.42	0.33	0.3953	2.36	0
D/A	0.19	0.17	0.1462	0.68	0
Illiquidity ratio	2,977.31	280.66	12,926.80	155,707.10	0.02

Source: compiled by the author

Despite the fact that mean dividend amount for Lithuania stocks was about 50% higher than for Latvia and Lithuania, the median value amounted to just 0.06 comparing 0.19 and 0.21 euro for TSE and RSE respectively. This gives a somewhat insight of stocks' attractiveness from the point of dividend capturing, which is further supported once average ex-dividend day trading volumes are compared. Number of Lithuania stocks traded were about 75% fewer than for Estonia. From the risk perspective mean and median values among stocks are quite similar. Median number of earning per share is also the lowest for VSE sample.

2.2. Variables used in the analysis

The ex-dividend day stock price behavior will be measured in three ways. First, the raw price-drop ratio (RPD) will be calculated by equation 3.1 as follows:

$$\mathrm{RPD} = \frac{\mathrm{P_c} - \mathrm{P_e}}{\mathrm{D}} \tag{3.1}$$

where
$\mathrm{P_c}$ – closing price on the cum-dividend day
$\mathrm{P_e}$ – closing price on ex-dividend day
D – dividend amount per stock

However, as mentioned by Elton and Gruber (1970) the ex-dividend day closing prices are affected not only by the transfer of a right for a dividend but may also reflect daily market fluctuation. Following Castillo and Jakob (2006) and Milonas et al. (2006) daily change between the cum-dividend and the ex-dividend days of OMX Tallinn GI, OMX Riga GI and OMX Vilnius GI indexes ($\mathrm{r_m}$) were used to account for this effect and calculate the second measure, i.e., the market-adjusted price-drop ratio (MAPD):

$$\mathrm{MAPD} = \frac{\mathrm{P_c} - \frac{\mathrm{P_e}}{1 + \mathrm{r_m}}}{\mathrm{D}} \tag{3.2}$$

According to Eades et al. (1984) the main problem of using a price-drop ratio in the regression analysis is that it suffers from heteroskedasticity, thus giving more weight to low-yielding stocks. So, the common practice is to focus on abnormal returns instead, calculated in accordance with the following:

$$\mathrm{AR} = \frac{\mathrm{P_e} - \mathrm{P_c} + \mathrm{D}}{\mathrm{P_c}} - \mathrm{r_m} \tag{3.3}$$

The standard explanations of the ex-dividend day puzzle encompass tax heterogeneity, arbitrage activity and market microstructural features. The relation between abnormal returns and dividend yields, evaluated as follows, can be used to helps to detect presence of tax-induced clientele along as short-term strading:

$$\mathrm{YIELD} = \frac{\mathrm{D}}{\mathrm{P_c}} \tag{3.4}$$

Under presence of short-term trading ex-dividend day premiums and average abnormal trading volumes should be affected by both risk and transaction costs. Following Michaely and Vila (1996) the abnormal trading volumes (AV) and average abnormal volumes (AAV) were measured as below:

$$\mathrm{AAV} = \frac{\sum \mathrm{AV}}{\mathrm{N}} \tag{3.5}$$

with

$$\mathrm{AV} = \frac{\mathrm{TO}}{\mathrm{ATO}} - 1 \qquad t = -5, \dots, 0, \dots, +5$$

and

$$\mathrm{ATO} = \frac{\sum_{t \in [-45,-6] \cup [+6,+45]} \mathrm{TO}}{\mathrm{T}}$$

where

TO − a relation of daily trading volume to the number of shares outstanding
ATO −average trading volume during the benchmark period
T − number of days with positive trading volumes during the benchmark period
N − number of observations

From various possible risk measures firm's risk and active risk were chosen for the analysis. The firm's risk (FRISK) was calculated as a standard deviation of stock returns during the benchmark period. The second risk measure active risk (ARISK) was imputed as a standard deviation of stock excess returns in relation to the respective index returns across benchmark period. As it is not feasible to obtain data about real transaction costs (TRCOST) the following proxy is used:

$$\mathrm{TRCOST} = \frac{1}{\mathrm{P_c}} \tag{3.6}$$

As Baltic stock markets are commonly considered being illiquid the question of how to measure the illiquidity was a concern. Florakis et al. (2011) introduced an improved version of Amihud's ratio, which makes it possible to compare stocks irrespective of market capitalization and possible effect of foreign exchange rates. The logic of the illiquidity ratio is to shows how increase in turnover, estimated by the equation (3.5) affects stock returns:

$$\text{ILLIQ} = \frac{|\text{R}|}{\text{TO}} \tag{3.7}$$

where
R − stock return of the ex-dividend day

Since one of the main focuses of the thesis is to determine whether stock price behavior on the ex-dividend day is partially defined by its' financials, the list of defining variables will be extended with profitability (ROE, ROA), leverage (D/E, D/A) and market value (P/B, P/E) ratios. Table 3.1. represents additional variables and calculation used in estimations.

Table 3.1. Calculation financial ratios

Symbol	Description	Calculation method
MCAP	market capitalization	$\text{number of shares outstanding} \times \text{P}_\text{c}$
EPS	earnings per share	$\frac{\text{net income for the year from which profits are distributed}}{\text{number of shares outstanding}}$
ROE	return on equity	$\frac{\text{net income for the year from which profits are distributed}}{\text{year average shareholders' equity}}$
ROA	return on assets	$\frac{\text{net income for the year from which profits are distributed}}{\text{year average total assets}}$
PB	price-to-book value	$\frac{\text{P}_\text{c} \times \text{number of shares outstanding}}{\text{year} - \text{end shareholders' eqiuty}}$
PE	price-to-earnings ratio	$\frac{\text{P}_\text{c}}{\text{EPS}}$
DE	debt-to-equity ratio	$\frac{\text{long} - \text{term debt} + \text{short} - \text{term debt}}{\text{year} - \text{end shareholders' eqiuty}}$
DA	debt-to-asset ratio	$\frac{\text{long} - \text{term debt} + \text{short} - \text{term debt}}{\text{year} - \text{end total assets}}$

Source: compiled by the author

To author's best knowledge, the possible impact of financial ratios was not assessed in previous empirical studies. Still, there are a number of papers that analyzed if stocks' abnormal returns in overall might be forecasted by such. Irrespectively of controversial opinions there is evidence that considering P/B and P/E ratios premiums could be forecasted in a short horizon. Higher P/E and P/B ratios are associated with lower premiums. (Jiang, Lee 2012; Lewellen 2004) Thereby, even without decomposition the role of financial ratios is tested in the current thesis.

2.3. Methodology

The methodology used in the analysis is event study. Tallinn, Riga and Vilnius stock exchange samples will be viewed separately. First, raw stocks' mean raw (RPD) and market-adjusted (MAPD) price-drop ratios, along with ex-day abnormal returns (AR), estimated using equations presented in section 3.1., will be compared with the values defined under the perfect capital market assumption. The theory states that on the perfect capital markets the price should decrease by a dividend amount, resulting price-drop ratio taking a value of 1 and abnormal returns approximating 0.

As it was proposed by the literature, to avoid that extreme observations affect results unduly, PDR and AR were trimmed by 2.5% from the top and bottom (Henry, Koski 2017; Rantapuska 2008; Graham et al. 2003). This meant excluding in total 6 observations for TSE, 4 for RSE and 10 for VSE sample. The trimmed samples were divided into two subsamples for the years 2000-2009 and 2010-2020, so detect changes in stock price behavior during the post crisis period. However, as 2000-2009 sample is affected by the economic recession to evaluate this influence mean RPD, MAPD and AR were for 2000-2020 excluding the period from the third quarter of 2007 until the end of 2009.

One of the proposed explanations of stock prices behaving in a contrast to the frictionless markets is heterogeneity of dividend and capital gain taxes (Elton, Gruber 1970). This proposition might be tested in several ways. First opportunity is to sort the sample by dividend yield or dividend size and examine mean price-drop ratios among the groups (Whitworth, Rao 2010; Jakob, Ma (2007). However, this method could roughly give trustworthy results considering the number of observations of TSE, RSE and VSE. Another widely used possibility to test the existence of tax-induced clientele effect is comparison of PRD and MAPD with values estimated by equation 1.2 (Jiang et al. 2019; Akhmedov, Jakob 2010). The common logic of this method was used in the analysis. Still, from authors' point of view, the better overview might be obtained if actual distribution of MAPD given a certain tax-clientele is analyzed. Thus, the expected values of PDR accounted for tax rates applied to resident and foreign individuals and corporations during the 2000-2020 were estimated. The rates for substantial holdings were taken into accounted if the laws of Estonia, Latvia and Lithuania implied different tax rates on such. The justification for that is that traded volumes must be sufficient to impact stock prices.

Next, the regression analyses were conducted to further find evidence whether tax hypothesis and/or short-term trading theory hold and to determine which factors have a significant impact on stocks abnormal returns. If abnormal return decrease for stock with higher yield and increase once transaction costs and risk are higher this should be treated as confirmation of short-term trading hypothesis. Following Dupuis (2019) the following model was estimated using pooled OLS. The standard errors were adjusted to account for heteroscedasticity:

$$\mathrm{AR}_{i,t} = \alpha_0 + \beta_1 \mathrm{RISK}_{i,t} + \beta_2 \mathrm{DEBT}_{i,t} + \beta_3 \mathrm{INC}_{i,t} + \beta_4 \mathrm{PB}_{i,t} + \beta_5 \mathrm{PE}_{i,t} + \beta_6 \mathrm{YIELD}_{i,t} + \beta_7 \mathrm{TRCOST}_{i,t} + \beta_8 \log(\mathrm{VOL})_{i,t} + \beta_9 \log(\mathrm{ILLIQ})_{i,t} + \beta_9 \log(\mathrm{MCAP})_{i,t} + \varepsilon_{i,t} \quad (3.8)$$

where

$\mathrm{AR}_{i,t}$ – stock's abnormal return on the ex-dividend day

$\mathrm{RISK}_{i,t}$ – one of the risk measures (ARISK or FRISK)

$\mathrm{DEBT}_{i,t}$ – financial leverage (D/E or D/A)

$\mathrm{INC}_{i,t}$ – profitability ratio (ROA or ROE)

$\mathrm{PB}_{i,t}$ – price-to-book ratio

$\mathrm{PE}_{i,t}$ – price-to-earnings ratio

$\mathrm{YIELD}_{i,t}$ – dividend yieldQ

$\mathrm{TRCOST}_{i,t}$ – proxy for transaction costs

$\mathrm{ILLIQ}_{i,t}$ – Florakis' illiquidity ratio

$\mathrm{VOL}_{i,t}$ – trading volume on the ex-dividend day

$\mathrm{MCAP}_{i,t}$ – stock market capitalization

To account for multicollinearity the correlation coefficient of independent variables were considered (Appendix 2-7). As several explanatory variables are highly correlated, only variables that improved model explanatory power were left. At first the regression for 2000-2020 was performed. As next step the model with the time dummy variable that equals 0 for 2000-2009 and 1 for 2010-2020 was performed again. In case the dummy variable having a significant impact on abnormal return, separate regressions for subperiods were conducted. As a robustness check, the model is run again for samples that do not include ex-dividend days for 2007Q3-2009.

Further mean abnormal trading volumes for the event window, estimated by equation (3.5), were analyzed. The event window includes the ex-dividend day and ten days surrounding it. This would give another insight of whether Baltic stocks are targeted by arbitrageurs. Finally, regression models were estimated as follows:

$$\mathrm{AAV}_{i,t} = \alpha_0 + \beta_1 \mathrm{RISK}_{i,t} + \beta_2 \mathrm{DEBT}_{i,t} + \beta_3 \mathrm{INC}_{i,t} + \beta_4 \mathrm{PB}_{i,t} + \beta_5 \mathrm{PE}_{i,t} + \beta_6 \mathrm{YIELD}_{i,t} + \beta_7 \mathrm{TRCOST}_{i,t} + \beta_9 \log(\mathrm{MCAP})_{i,t} + \varepsilon_{i,t} \quad (3.9)$$

where independent variables are the same as for equation (3.8)

Also, this model is estimated with pooled OLS. Similarly to model (3.8) the adjustment for heteroskedasticity is applied and right-side variables' correlations are considered. Also, separate models were estimated if a time dummy variable was significant. Yet again, the robustness of the model specifications was examined by rerunning the regression excluding 2007Q3-2009Q4 period from the examined.

3. RESULTS

3.1. Results for Tallinn Stock Exchange sample

This section presents the results of the analysis of stock price behavior on the ex-dividend day for Tallinn, Riga and Vilnius stock exchanges. As it was previously mentioned in a perfect market a stock price should decrease by the dividend amount, resulting in a price drop ratio being equal to 1 and abnormal returns to zero.

As it can be observed from the table 3.5. the mean raw (RPD), the market-adjusted price drop (MAPD) ratios and the ex-dividend day mean abnormal returns (AR) are not statistically different from their expected values. This holds also after trimming the sample by 2.5% from both sides and once the sample is divided into two subperiods (2000-2009 and 2010-2020). However, it is worth noting that abnormal returns for the post-post crisis period are on average a little higher than the average for the whole period 2000-2020. The exclusion of ex-dividend days taken place during the global financial crisis from the third quarter of 2007 until the end of 2009 did not substantially change the finding, thus leading to a conclusion that the crisis did not affect the RPD, MAPD and AR for the TSE sample.

Table 3.5. The comparison of expected and observed price-drop ratios and abnormal stock returns for TSE stocks

Variable	Theoretical mean value	Mean value	Mean 2000-2020 (trimmed)	Mean 2000-2009 (trimmed)	Mean 2010-2020 (trimmed)	Mean 2000-2020 (excl 2007Q3-2009)
RPD	1	0.8866	0.9075*	0.9201	0.8975	0.9362
MAPD	1	0.9356	0.9401	0.9272	0.9503	0.9769
AR	0	0.0008	0.0005	-0.0012	0.0017	-0.0002

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

Given such persistent results, does that indicate that throughout past two decades the stocks' price drop ratios are closely scattered around the one? Are investors' tax rates on capital gains and dividends homogeneous enough to be in line with Elton and Gruber's hypothesis? From figure 3.1, which shows the distribution of price-drop ratios, it might be seen that starting from 2006 the deviation of observations substantially increased. The lines in the figure represent price-drop ratios derived from tax-induced client theory for resident individuals (RI), foreign individuals (FI), resident corporations (RC) and foreign corporations (FC) with a substantial holding in a domestic company. If the theory holds stocks' actual price-drops should be restricted by the burdens. However, there is a little evidence of such after 2005. This might be explained by the change in the law in 2006, which made it no longer possible to reduce the taxable base by the amount of loss incurred due to selling a stock, which was purchased and disposed during 30 days around the ex-dividend day.

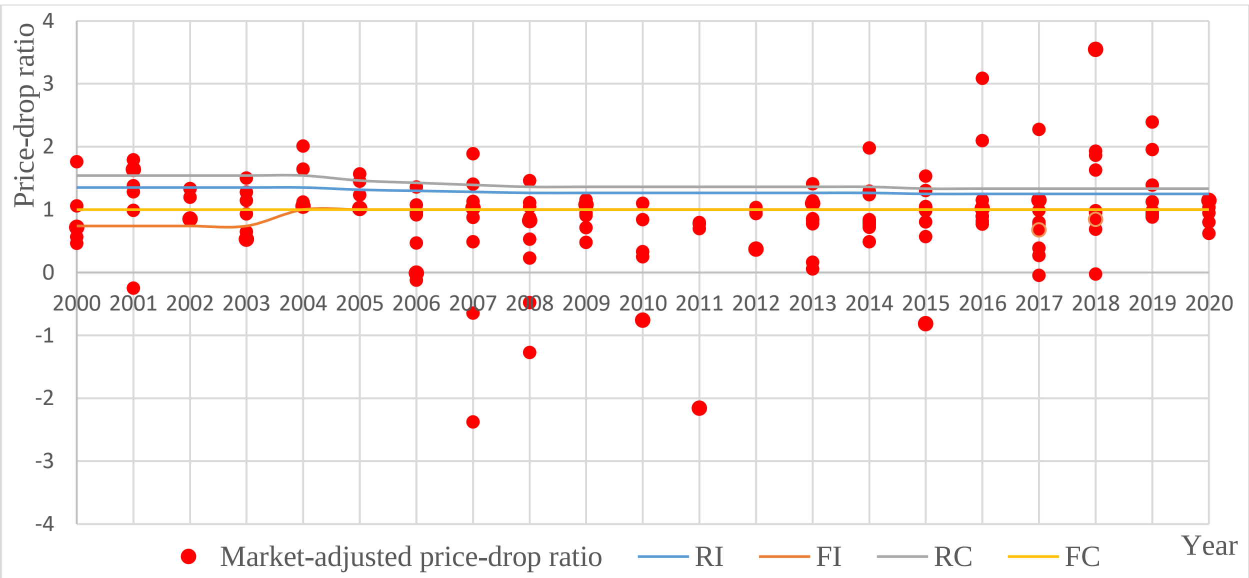

Figure 3.1. Price-drop ratio breakdown by year for TSE sample
Source: author's calculations
Note: the following observations were eliminated for representational purposes: 6.1, 5, and -5.1

Even though on average results satisfy the perfect market assumption, the regression analysis for the trimmed sample (1) as explained in section 2.3, is performed to specify which factors stand behind any deviation from the complete price adjustment (see table 3.6). The regression analysis for TSE sample confirmed that stock's abnormal returns are affected by active risk, evaluated as a standard deviation of excess returns during the benchmark period. An increase in a volatility by 1% will increase abnormal returns by 0.61 percent point, perhaps due to the short-term traders limiting the wealth they were willing to contribute with intention to benefit from the phenomenon, thus decreasing the extent of mispricing. The second regression (2) with a dummy variable (dummy1), which takes the value of 0 for 2000-2009 and 1 for subsequent years, indicated that during the post-crisis period abnormal returns increased by 0.94 percent point, thus, two separate regressions were run for the periods. The risk had more impact on abnormal returns during 2000-2009 (4) than for later years (5). Still, as the crisis period may bias the result of the regression 4, an additional robustness test was performed by excluding ex-dividend days for the period starting from the third quarter of 2007 and ending in 2009 (6). The results show a decrease of the impact of active risk, i.e., a 1% increase in risk measure is associated with an increase in abnormal returns by 0.41 percent point.

The relationship between dividend yield and abnormal returns also supports the arbitrage hypothesis, as high-yielding stocks are more likely to be targeted for implementing dividend capturing. A 1% increase in yield is associated with a decrease of abnormal returns by 0.15 percent point (1). This relation is quite steady considering that results of the regression (4) are affected by the recession. For the post-crisis period (5), the dividend yield does not seem to be relevant anymore.

Although the regression results show that transaction costs are important, in most cases the sign contradicts the theoretical proposition. The reason for that might be related to stocks with low prices performing in a different way on the ex-dividend day. To check this proposition the regression (3) for stocks with a minimum price of 4 euros on the cum-dividend day was run. In most empirical studies that analyze ex-dividend day stock price behavior stock prices are restricted to a minimum of 5 dollars; however, given the Estonian market, after the limitation a number of observations amounted to just 74 and transaction costs do not seem to affect abnormal returns anymore.

Trading fees are also commonly expected to be inversely related to size of a company. However, the sign of this control variable also contradicts the theory. An increase of 1% in market capitalization will increase abnormal returns of around 0.50 percent point according to the estimation in (2) and becomes insignificant after 2009. Another variable that drives premiums and has a sign that does not conform the theory is illiquidity. After performing several robustness tests the results remained the same, an increase in illiquidity will decrease abnormal returns. This is consistent with Dupius' findings for UAE markets, which are also assumed being highly illiquid and could not been explained by him.

Table 3.6. Pooled OLS regression output for TSE stocks with abnormal returns as a dependent variable

Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.0518** (0.0202)	-0.0527** (0.0204)	-0.1062*** (0.0257)	-0.0901*** (0.0146)	0.0027 (0.0267)	-0.0410** (0.0199)
ARISK	0.6062*** (0.1792)	0.7774*** (0.1675)	-	0.8173*** (0.1898)	0.5657** (0.252)	0.4142** (0.1934)
FRISK	-	-	0.6188** (0.2930)	-	-	-
D/A	-	-0.0088 (0.0096)	0.0172 (0.0152)	-	-	-
D/E	-0.0032 (0.0035)	-	-	0.0051 (0.0088)	-0.0049 (0.0044)	-0.0048 (0.0035)
log(ILLIQ)	-0.0016** (0.0007)	-0.0019*** (0.0007)	-0.0009 (0.0009)	-0.0015** (0.0006)	-0.0047*** (0.0013)	-0.0019** (0.0008)
log(MCAP)	0.0057** (0.0017)	0.0050*** (0.0019)	0.0066*** (0.0025)	0.0074*** (0.0015)	0.0035 (0.0023)	0.0051*** (0.0017)
P/B	-0.0015 (0.0020)	-0.0009 (0.0020)	0.0006 (0.0015)	-	-0.0098** (0.0047)	-0.0007 (0.0018)
P/E	1.92×10^{-5} (3.54×10^{-5})	2.06×10^{-5} (3.69×10^{-5})	0.0002*** (6.23×10^{-5})	-0.0001 (0.0001)	4.20×10^{-5} (3.32×10^{-5})	2.60×10^{-5} (3.50×10^{-5})
ROA	-0.0386** (0.0186)	-0.0242 (0.0186)	-	-0.0293 (0.018)	-	-0.0479*** (0.018)
ROE	-	-	0.0227 (0.0158)	-	0.0221 (0.0263)	-
TRCOST	-0.0099* (0.0053)	-0.0126** (0.0049)	0.0524 (0.0407)	0.0202** (0.0084)	-0.0247*** (0.0051)	-0.0115** (0.0056)
YIELD	-0.0015*** (0.0006)	-0.0015*** (0.0006)	-0.0012** (0.0006)	-0.0022*** (0.0004)	-0.0011 (0.001)	-0.0015** (0.0006)
Dummy1	-	0.0094** (0.0041)	0.0151*** (0.0057)	-	-	-
log(VOL)	-	-	-	-	-	-
N	138	138	74	59	79	124
F-statistic	3.2721	3.5414	4.4855	5.2823	3.6770	3.0234
p (F-statistic)	0.0013	0.0004	0.0001	0.0001	0.0008	0.0028
R^2	0.1870	0.2180	0.4159	0.4580	0.3241	0.1927

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

One of the questions the thesis aimed to answer was whether the company's fundamentals to some extent have been responsible for how stocks behave on ex-dividend days. The results do not indicate that companies' leverage play an important role maybe due to the fact that Estonian firms are relatively low in it, with 18% and 17% of total assets on average and as a mean value respectively. There are signs that after the crisis that stocks with a higher price-to-book ratio have lower abnormal returns. The coefficient of the price-to-earnings ratio is statistically significant only for the sample of stocks having a minimum price of 4 euros. However, it should be taken into account that the sample encompasses the recession period and the coefficient is almost negligible. Stocks of firms with a higher return on assets on average during the observed period adjusted more completely on the ex-dividend day. An increase of 1% in the ratio decreased abnormal returns by 0.04 percent points (1) and by 0.05 percent points once the crisis period is excluded (2).

Further the short-term trading theory is tested. Table 3.7 shows average abnormal trading volumes within the event window, estimated in accordance with equation 3.5. According to the information presented in below abnormally high trading activity might be observed not only on the ex-dividend day, but also during the preceding five and subsequent two days after the ex-day. On the cum-dividend day (indicated as -1 in table 3.7) and on the ex-dividend day on average stocks are traded respectively 39 and 15 times more than on average during the benchmark period, which encompass 80 days around the event window, presented below further confirming the presence of dividend capturing strategy.

Table 3.7. Average abnormal trading volumes (AAV) around the ex-dividend day for TSE sample during 2000-2020

Day	AAV	t-Statistic	p-value
+5	0.6207	0.9416	0.3481
+4	1.0949	1.1962	0.2337
+3	1.3702	1.0913	0.2771
+2	2.5721	2.2332	0.02714**
+1	3.5878	1.8440	0.06734*
Ex-day	15.1211	3.2773	0.001316***
-1	39.4477	4.9796	1.83×10^{-6}***
-2	3.5432	2.5148	0.01303**
-3	2.3845	1.9060	0.05877*
-4	0.3234	2.4635	0.0150**
-5	0.5269	2.2675	0.0250**

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

The literature outlines, how risk, transaction costs and yield should be related to average daily abnormal trading volumes to further indicate a presence of arbitrage activity, so the regression analyses with average abnormal trading volumes for the event window were performed. The results are presented in table 3.8.

Table 3.8. Pooled OLS regression output for TSE stocks with average abnormal trading volumes as a dependent variable

Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	50.1977* (28.0732)	51.2963* (26.8661)	107.9535*** (38.2997)	69.1288** (26.4617)	1.2698 (1.6182)	23.4287* (13.1881)
ARISK	-145.2917 (157.0719)	-437.2392* (222.2608)	-	-693.6873* (390.9026)	-11.2903 (24.185)	-
FRISK	-	-	-175.9809 (260.3031)	-	-	56.7188 (199.4571)
D/A	-16.4402*** (5.8242)	-6.7822 (6.1465)	-30.8028** (13.2478)	-30.8597* (17.2895)	-1.1318 (1.7742)	-17.0987*** (5.6463)
D/E	-	-	-	-	-	-
log(MCAP)	-2.2764 (1.5853)	-0.9597 (1.3552)	-4.6520* (2.4351)	-	0.0633 (0.1030)	-
P/B	-0.9900 (0.9714)	-2.2312* (1.3420)	-2.2016** (1.0658)	-3.7669** (1.5687)	-	-2.3626 (1.5217)
P/E	-0.0101 (0.0159)	-0.0068 (0.0141)	-0.1097 (0.0945)	-0.0523 (0.1554)	-0.0003 (0.0021)	-0.0069 (0.0182)
ROA	-	-	-7.9247 (20.7671)	-25.4633 (33.0487)	-3.5911 (3.6132)	-
ROE	18.8000 (15.3803)	5.5188 (15.3734)	-	-	-	24.0964 (17.183)
TRCOST	-14.1962** (5.8157)	-9.9618** (4.0364)	-103.0499* (58.9343)	-27.5115** (13.0447)	-1.1249** (0.5577)	-14.1529** (6.6474)
YIELD	-1.2375 (0.8141)	-1.2387 (0.8018)	-0.6972 (0.6728)	-2.3546 (1.5160)	0.0026 (0.0502)	-1.6032 (1.1128)
Dummy1	-	-16.3431*** (5.4185)	-14.9492*** (4.6026)	-	-	-
N	144	144	76	63	81	128
F-statistic	3.1594	5.8200	4.5721	2.4814	0.9146	3.0393
p (F-statistic)	0.0026	0.0000	0.0001	0.0274	0.5002	0.0056
R^2	0.1577	0.2810	0.3840	0.2400	0.0806	0.1506

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

As dividend yield does not seem to be a material factor, it is likely that the proposition that high-yielding stocks are targeted by short-term traders was not supported. Active risk is significant at 10% level in models for stocks with a minimum price restriction and for the 2000-2009 model. However, once again the results might be affected by the time of the recession. Consistent with the literature lower trading volumes are associated with higher transaction costs. The results of the regression (2) confirm that average abnormal daily trading volumes decreased by 16 times since 2010 in comparison to the previous years.

Differently from the results for abnormal return, the leverage of companies has a statistically significant and negative impact on trading volumes in model (1) for a whole sample. An increase on leverage by 1% will lead to a decrease in average trading volumes by 16 percent point. After excluding the period attributed to the global financial crisis an impact of leverage increased to 17 percent point in model 6. Nether companies' profitability nor price-to-earnings ratio do not appear to affect ex-dividend day stock price behavior.

Nevertheless, there is an indication of stocks with lower price-to-book value being targeted by investors. To conclude, even though, the results of the regressions do not evidence that yield is an important factor in dividend capturing, abnormal trading volumes around ex-days are the main supporting argument. Still, there is a sign that stocks' peculiarities may also drive abnormal trading, i.e., investors could possibly postpone the portfolio adjustment until the right for the dividend is lost and a stock is traded at a lower price.

3.2. The results for Riga Stock Exchange sample

The analyses undertaken for Tallinn stock exchange are now repeated for Riga stock exchange. As it may be observed from table 3.9., differently from the TSE sample, the mean raw (RPD), market-adjusted price drop (MAPD) ratios are statistically less than 1 and the ex-dividend day mean abnormal returns (AR) for RSE stocks are highly positive. However, since 2010 there is a significant increase in price adjustment so that on average during the last decade prices dropped by around 73% or 89% of the dividend amount after adjustment for the daily market fluctuation.

During 2000-2009 the mean raw and market-adjusted price-drop ratios amounted to just 30% and 48%. The subsample should not be heavily influenced by the global financial crisis as there was only a few dividend payouts during the last two quarters of 2007 until 2010 (Figure 3.2). The pattern observed on figure 3.2. does not support the theory that tax heterogeneity is somehow responsible for prices falling on average that much less then it was predicted by Elton and Gruber.

Table 3.9. The comparison of expected and observed price-drop ratios and abnormal stock returns for RSE stocks

Variable	Theoretical mean value	Mean value	Mean 2000-2020 (trimmed)	Mean 2000-2009 (trimmed)	Mean 2010-2020 (trimmed)	Mean 2000-2020 (excl 2007Q3-2009)
RPD	1	0.5472***	0.5765***	0.3028***	0.7278***	0.5404***
MAPD	1	0.7400**	0.7427***	0.4790***	0.8885	0.7454***
AR	0	0.0120***	0.0100***	0.0127***	0.0084**	0.0100***

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

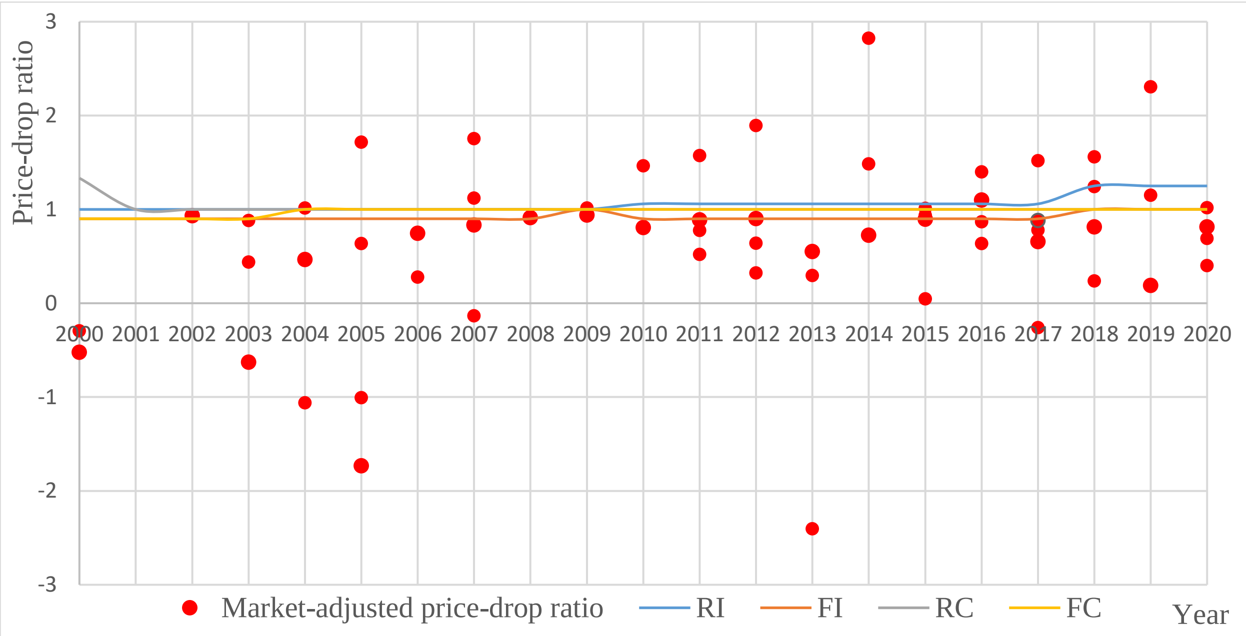

Figure 3.2. Price-drop ratio breakdown by year for RSE sample
Source: author's calculations

Next, three pooled OLS regressions were performed on the RSE sample to identify factors that drive or predict the ex-dividend day premiums. The outcomes of the regressions are presented in table 3.10. Model 1 shows the results for 2000-2020, in model 2 the time dummy (dummy1), which is equal to o for 2000-2009 and 1 for 2010-2020, is included. In model 3 the period 2007Q3-2009Q4 was eliminated. From all three models only the third one appeared to be significant at a 10% level.

Given the small number of observations, and a possible effect of the global financial crisis it is not surprising that the coefficients of variables such as the dividend yield, trading volumes, risk, profitability and leverage measures are not statistically significant in all models. For the RSE sample the proxy for transaction costs and the logarithm of a stock's market capitalization are highly correlated (correlation coefficient of -0.69), thus only the latter was considered as it improved the models' explanatory power. Increase in market capitalization by 1% will reduce ex-dividend day abnormal returns by 0.5 percentage points (3). This is consistent with theory that transaction costs represented by companies' size increase premiums.

Table 3.10. Pooled OLS regression output for RSE stocks with abnormal returns as a dependent variable

Independent variable	(1)	(2)	(3)
Intercept	0.0854*** (0.0310)	0.0838** (0.0323)	0.0834** (0.0317)
ARISK	-0.2698 (0.2447)	-0.2949 (0.2410)	-
FRISK	-	-	-0.2430 (0.3027)
D/A	-0.0328 (0.0256)	-0.0299 (0.0274)	-0.0164 (0.0251)
D/E	-	-	-
log(ILLIQ)	-	-	-
log(MCAP)	-0.0040** (0.0016)	-0.0037** (0.0016)	-0.0052** (0.0020)
P/B	0.0086 (0.0052)	0.0079 (0.0056)	0.0106* (0.0055)
P/E	-0.0006* (0.0004)	-0.0006* (0.0004)	-0.0005* (0.0003)
ROA	-	-	-
ROE	-0.0725 (0.0631)	-0.0664 (0.0698)	-0.0747 (0.0612)
TRCOST	-	-	-
YIELD	-0.0007 (0.0009)	-0.0006 (0.001)	0.0010 (0.0008)
Dummy1	-	-0.0029 (0.0061)	-
log(VOL)	-0.0017 (0.0018)	-0.0017 (0.0018)	-0.0017 (0.0018)
N	59	59	54
F-statistic	1.6639	1.4809	2.1512
p (F-statistic)	0.1308	0.1816	0.0501
R^2	0.2102	0.2138	0.2766

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

Among transaction costs the price-to-book and the price-to-earnings ratios are both significant at a 10% level in model 3. A decrease in relative market value of a stock to its book value by 1 will result in a decline of abnormal returns by 1.06 percentage points. This suggests that investors who realize the potential opportunity the phenomenon provides and have an intention to complement their investment portfolios are more likely to postpone the execution of a trade until the ex-dividend day. The regression results corroborate that among lower P/B ratio, investors will also focus on stocks with higher P/E ratio if they believe that it represents stock's future returns. The dummy variable is not statistically significant in model 2 and total number of observations is not sufficient to conduct separate regressions for subperiods. The restriction of a price minimum level to 4 euros would leave only 37 observations, so no separate analysis was performed.

Table 3.11. represents abnormal average daily trading volumes (AAV) on the ex-dividend day and for 10 days surrounding it. Considering the information presented in the table there is a little evidence that Latvian stocks are attractive from the point of short-term trading. Despite the ex-dividend day volumes being 57% higher than on average during the reference period, those are significant only at the 10% level. On contrary, there is an abnormally low trading activity on the second and third day after the ex-dividend day.

Table 3.11. Average abnormal trading volumes around the ex-dividend day for RSE sample during 2000-2020

Day	AAV	t-Statistic	p-value
+5	0.0781	0.2474	0.8055
+4	-0.0564	-0.3223	0.7485
+3	-0.2765	-2.2883	0.02585**
+2	-0.3300	-3.0261	0.0038***
+1	0.0464	0.1381	0.8907
Ex-day	0.5738	1.6937	0.0954*
-1	0.2130	1.1916	0.2381
-2	0.0324	0.1965	0.8449
-3	0.1555	0.8298	0.4105
-4	0.0317	0.1811	0.8570
-5	-0.0971	-0.4638	0.6446

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

Further, the regressions were conducted to examine which stock features that may engage investors in trading activity. Table 3.12. reflect the output for three models, specified similarly to the regressions for abnormal returns. Analogously, only the model that does not encompass the crisis period is statistically significant.

Table 3.12. Pooled OLS regression output for RSE stocks with average abnormal trading volumes as a dependent variable

Independent variable	(1)	(2)	(3)
Intercept	0.2977 (0.3353)	-0.1757 (0.7905)	0.0781 (0.3458)
ARISK	-	-	-
FRISK	-30.4548** (12.4828)	-25.8255** (10.1460)	-38.445*** (13.7056)
D/A	-	-	-
D/E	0.5202 (0.3927)	0.7362* (0.4206)	0.6202 (0.3724)
log(MCAP)	-	0.0593 (0.0588)	-
P/B	0.0408 (0.1722)	-0.1143 (0.1767)	0.1273 (0.1702)
P/E	-0.0056 (0.0085)	-0.0039 (0.0094)	-0.0048 (0.0090)
ROA	-	0.9505 (2.0367)	-
ROE	-0.2802 (1.5009)	-	-0.5866 (1.4628)
TRCOST	0.2740 (0.2989)	-	0.5131 (0.3120)
YIELD	0.0444 (0.0267)	0.0533* (0.0278)	0.0801*** (0.0295)
Dummy1	-	-0.3059 (0.1907)	-
N	63	63	58
F-statistic	1.7627	1.7554	2.6190
p (F-statistic)	0.1137	0.1067	0.0220
R^2	0.1832	0.2064	0.2683

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

Consistent with short-term trading theory the coefficients of the dividend yield and risk are both significant at the 99% confidence levels in the model, respectively. A 1% increase of yield is associated with an increase in the average daily abnormal volumes by 8 percentage points. Once stock price volatility increases by 1%, abnormal trading volumes decrease by 38 percent points according to model 3.

Although the time dummy variable is not statistically significant, still it may be concluded that trading volumes were lower since 2010. Neither transaction costs nor other variables do not seem to affect trading activity. There is a slight sign of leverage being positively associated with trading volumes, although it does not appear to be logical that companies having more debt are more likely to attract potential stockholders.

3.3. The results for Vilnius Stock Exchange sample

Finally, the analyses performed for TSE and RSE stock exchanges is repeated for Vilnius stock exchange. Similarly to the RSE results the information presented in table 3.13. indicate that on average Lithuanian stock prices drop by approximately only 60% of a dividend amount. Since 2010 there was an increase of about 10 and 6 percent point in RPD and MAPD respectively, and consequently a 0.4 percent point decrease in abnormal returns.

Table 3.13. The comparison of expected and observed price-drop ratios and abnormal stock returns for VSE stocks

Variable	Theoretical mean value	Mean value	Mean 2000-2020 (trimmed)	Mean 2000-2009 (trimmed)	Mean 2010-2020 (trimmed)	Mean 2000-2020 (excl 2007Q3-2009)
RPD	1	0.5278***	0.5184***	0.4371***	0.5676***	0.5517***
MAPD	1	0.5799***	0.5755***	0.5127***	0.6135***	0.6149***
AR	0	0.0192***	0.0184***	0.0220***	0.0162***	0.0164***

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

Yet again, considering the pattern on figure 3.3. it is hard to explain such incomplete price decrease by the difference in tax rates investors are a subject to. However, since 2011 price-drop ratios are in most cases positive and only a few times exceed the value of 1. The negative value of MAPD indicates that a stock price increased even after the transfer of a dividend right, hence the value of more than one means that a price dropped by more than the dividend. Such narrowed pattern could be a result of short-term traders that realized the opportunity ex-dividend days offer.

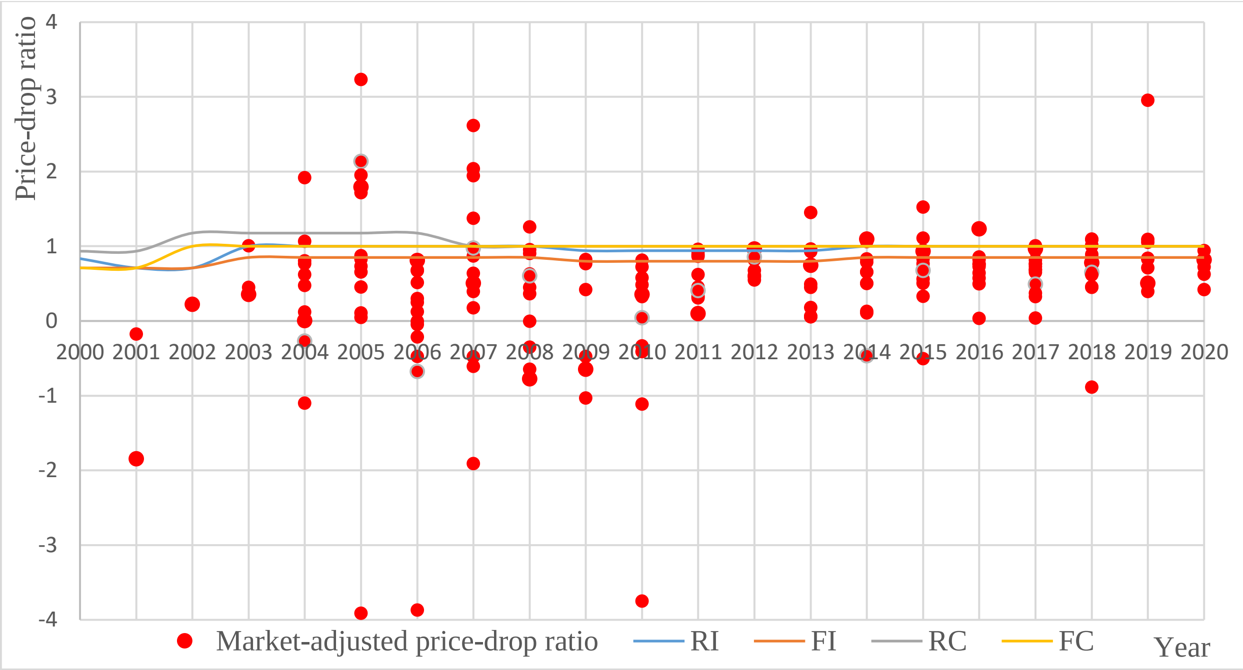

Figure 3.3. Price-drop ratio breakdown by year for VSE sample
Source: author's calculations
Note: following observations were eliminated for representational purposes: 10.3, 5.7, 4.5, -4.7

As the VSE sample has more observations than the TSE and RSE samples, it was expected to get a precise overview of factors affecting stocks' returns in illiquid markets. The results of three conducted regressions are presented in table 3.14. In model 1 the results for 2000-2020 of trimmed sample are shown. In model 2 the time dummy (dummy1), which is same as in previous regressions, is included. Model 3 encompass the period of 2000-2020, excluding 17 observations that fall within the period from the third quarter of 2007 to the end of 2009.

In all models the risk variable does not seem to affect ex-dividend day premiums in Lithuania stock market. The most interesting finding is that dividend yield, which is significant at the 1% level, is positively related to abnormal returns. It is roughly possible to find such examples in the literature that examines the phenomenon and this totally contradicts the dividend capturing theory. An increase in dividend yield by 1% is associated with an increase of abnormal returns by 0.16 percentage point, meaning that high-yielding stock prices adjust less perfectly. One of the possible explanations is that the net dividend is actually not sufficient to engage traders in arbitrage, e.g., the median dividend of VSE stocks is just 6 euro cents. In comparison the median dividend is 19 and 21 euro cents for TSE and RSE samples, respectively.

Table 3.14. Results of pooled OLS regression for VSE stocks with abnormal returns as a dependent variable

Independent variable	(1)	(2)	(3)
Intercept	0.0173 (0.0158)	0.0244 (0.0188)	0.0159 (0.0151)
ARISK	0.4174 (0.2801)	0.3269 (0.2648)	0.2356 (0.2766)
FRISK	-	-	-
D/A	-	-	-0.0038 (0.0092)
D/E	0.0004 (0.0032)	0.0001 (0.0028)	-
log(ILLIQ)	-0.0050*** (0.0015)	-0.0047*** (0.0016)	-0.0049*** (0.0015)
log(MCAP)	0.0052** (0.0024)	0.0048** (0.0024)	0.0056*** (0.0017)
P/B	-	-	-
P/E	-0.0001*** (2.88×10^{-5})	-0.0001 (2.69×10^{-5})	-9.79×10^{-5}*** (2.68×10^{-5})
ROA	-	-	-
ROE	0.0094 (0.0081)	0.0068 (0.0099)	0.0093 (0.0094)
TRCOST	0.0077*** (0.0026)	0.0073** (0.0029)	0.0075*** (0.0026)
YIELD	0.0016*** (0.0005)	0.0016*** (0.0005)	0.0015*** (0.0006)
log(VOL)	-0.0063*** (0.0014)	-0.0062*** (0.0014)	-0.0063*** (0.0013)
Dummy1	-	-0.0037 (0.0053)	-
N	183	183	166
F-statistic	5.7543	5.2935	4.1808
p (F-statistic)	0.0000	0.0000	0.0001
R^2	0.2304	0.2353	0.1943

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

Despite the fact that transaction costs are an important factor in driving premiums, risk turned out to not have a material impact. In all models the extent to which an increase in trading volumes affects abnormal returns is quite similar. According to model (1) and (3), a 1% increase of trading volumes is associated with abnormal returns being 0.63 percentage point lower. Similarly to the results obtained for the TSE sample, stocks with lower illiquidity and higher market capitalization cause are associated with higher abnormal returns. Although, out of all financial ratios only price-to-earnings ratio is significant, considering the coefficient it has a negligible impact on ex-dividend day stock price behavior.

Previously discussed regression results were ambiguous in relation to the dividend-capturing theory. To achieve greater clarity the trading activity around the ex-dividend day is examined. Following the information presented in table 3.15. daily trading volumes on the cum-dividend day are 86% higher than during the benchmark period. At the same time, the ex-dividend day trading volumes are half as high as on the preceding day.

Table 3.15. Average abnormal trading volumes around the ex-dividend day for VSE sample during 2000-2020

Day	AAV	t-Statistic	p-value
+5	-0.1868	-1.8783	0.0621*
+4	-0.1516	-1.8435	0.0670*
+3	0.8061	0.9254	0.3561
+2	1.0260	1.5000	0.1356
+1	0.1263	0.7348	0.4635
Ex-day	0.4312	2.6596	0.0085***
-1	0.8641	3.4365	0.0007***
-2	0.7703	1.5204	0.1302
-3	0.1413	0.9540	0.3414
-4	0.1079	0.7391	0.4608
-5	-0.1433	-1.4542	0.1477

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

The information presented in table 3.16. provides insights about the stock characteristics that drive abnormal trading volumes on VSE. In support of the short-term trading theory the coefficient of the dividend yield is positively associated with abnormal trading volumes at the 90% confidence level in model 1 for the whole period and in model 2 with a time dummy variable. Moreover, the coefficient of yield is highest in model 3, which do not include observation for 2007Q3-2009Q4. The economic interpretation of model 3 is that 1 % increase of dividend yield provided an excess of 9% of abnormal trading volumes.

Table 3.16. Results of pooled OLS regression for VSE stocks with average volumes of abnormal trading as a dependent variable

Independent variable	(1)	(2)	(3)
Intercept	1.4698 (1.5176)	1.4852 (1.4161)	0.7601 (1.5208)
ARISK	-32.4088*** (11.1504)	-32.6013*** (10.6136)	-32.1514** (12.7365)
FRISK	-	-	
D/A	-1.9179*** (0.6270)	-1.9208*** (0.6107)	-1.6649*** (0.6316)
D/E	-	-	-
log(MCAP)	-0.0564 (0.1326)	-0.0570 (0.1287)	-0.0132 (0.1389)
P/B	0.0631* (0.0380)	0.0630 (0.0395)	0.0562 (0.0423)
P/E	-	-	-
ROA	1.4978 (1.2104)	1.4890 (1.2233)	1.7692 (1.3706)
ROE	-	-	-
TRCOST	-0.0179 (0.1109)	-0.0179 (0.1110)	0.0199 (0.1178)
YIELD	0.0705* (0.0401)	0.0707* (0.0402)	0.0933** (0.0426)
Dummy1	-	-0.0076 (0.1714)	-
N	193	193	176
F-statistic	3.0235	2.6314	3.0967
p (F-statistic)	0.0049	0.0094	0.0043
R^2	0.1027	0.1027	0.1143

Source: compiled by the author

Note: *, **, *** indicate a significance at 10%, 5%, 1%

Another important factor that affects trading volumes is leverage. Considering overall economic stability of Lithuania and higher portion on debt in relation to the total assets makes the investment riskier and less appealing. Other financial ratios were not relevant in all models. Yet, out of all explanatory variables, active risk seems to impact trading volumes more heavily, i.e., abnormal trading volumes decreased by 32 percentage points once risk increased by 1%.

3.4. Summary of the results

The empirical analysis revealed that stocks of Estonian companies on average adjusted more completely during 2000-2020 amounting to over 90% of a dividend amount (see table 3.17.).

However, considering the pattern of actual price-drop ratios do not allow to draw the conclusion that there was no ex-dividend day anomaly on TSE. The prices of Latvian and Lithuanian stocks dropped by around 74% and 58% after accounting for the general market developments. Considering the possible effects of the global financial crisis, ex-dividend day measures were computed disregarding the period lasted from the third quarter of 2007 and until the end of 2009. After accounting for the crisis, the MAPD of TSE and VSE increased by 3 and 4 percentage point respectively, while leaving RSE sample almost unchanged.

Table 3.17. Summary of ex-dividend day stock price behavior on TSE, RSE and VSE

Variable	H_0	Mean value			Mean value (2.5% trimmed)		
		TSE	RSE	VSE	TSE	RSE	VSE
RPD	1	0.8866	0.5472***	0.5278***	0.9075*	0.5765***	0.5184***
MAPD	1	0.9356	0.7400**	0.5799***	0.9401	0.7427***	0.5755***
AR	0	0.0008	0.0120***	0.0192***	0.0005	0.0100***	0.0184***
Variable	H_0	Mean value 2000-2009 (trimmed)			Mean value 2010-2020 (trimmed)		
		TSE	RSE	VSE	TSE	RSE	VSE
RPD	1	0.9201	0.3028***	0.4371***	0.8975	0.7278***	0.5676***
MAPD	1	0.9272	0.4790***	0.5127***	0.9503	0.8885	0.6135***
AR	0	-0.0012	0.0127***	0.0220***	0.0017	0.0084**	0.0162***
Variable	H_0	Mean value (excl 2007Q3-2009)					
		TSE	RSE	VSE			
RPD	1	0.9362	0.5404***	0.5517***			
MAPD	1	0.9769	0.7454***	0.6149***			
AR	0	-0.0002	0.0100***	0.0164***			

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

To check for a possible change in stock price behavior in post-crisis years the samples were divided into two subperiods: 2000-2009 and 2010-2020. It appears that starting from 2010 MAPD of the RSE sample increased from 48% to 89%, while the change for VSE stocks was from 55% (with 4% attributable to the crisis) to 61% and remained unchanged for TSE.

According to the hypothesis proposed by Elton and Gruber (1970) price-drop ratios might be predicted by tax rates applied on capital gains and dividend. Nevertheless, as it was observed from the figures presented in sections 3.1, 3.2, and 3.3 there is a little evidence that this theory holds for Baltic markets.

The regression analyses performed with intention to identify what drives Baltic stocks' abnormal returns and to test the presence of short-term trading showed that risk is a material factor that drives ex-dividend day premiums only for the TSE sample, thus confirming the arbitrage theory. Another support of the hypothesis is that dividend yield appeared to be significant and inversely related to abnormal returns. Despite the fact that the dividend yield seemed to be relevant for VSE stocks, the sign contradicted the theory, potentially due to a domination of small dividend amounts. For the RSE importance of yield was not confirmed.

Although, transaction costs, expressed as proxy, were relevant both in TSE and VSE models, only the latter's sign was as expected, meaning that higher transaction costs would restrict the extent of short-term trading. Company's market capitalization was significant in regressions for all three exchanges.

Surprisingly, more illiquid stocks are associated with lower premiums on TSE and VSE. At the same time, results of VSE indicate that increase in trading volumes also decrease abnormal returns. Similarly to leverage, price-to-book did not appear to have a significant impact on stocks' abnormal returns of Baltic stocks. However, there was a sign that stocks with higher price-to-earnings ratios on VSE and profitability ratios on TSE do exhibit lower premiums.

The analysis of trading volumes within the event window (Table 3.17.) revealed abnormally high volumes for the TSE sample from the fifth day before and until the third day after the ex-dividend day. Extremely higher volumes are observed on the day preceding and the event day, amounting to 39 and 15 times normal volumes, estimated during the control period. At a much lower extent, 86% and 43% higher volumes were also observed on the cum-dividend and the ex-dividend day on VSE. Finding for both exchanges further conform the presence of dividend capturing. There is a little evidence that RSE stocks attract market participants who intend to implement arbitrage strategies.

The results of the regressions showed an increase in volumes for higher dividend yields and a decrease for riskier stocks only for RSE and VSE sample, being insignificant for TSE. Yet, it appeared that transaction costs are important only for the latter. As it was previously mentioned there was no evidence that leverage affected the abnormal return. However, a negative impact of debt affecting trading volumes was detected on TSE and VSE. Once again, a time dummy variable was significant only for TSE, indicating significantly lower trading volumes during the post crisis period.

Table 3.17. Summary of average abnormal trading volumes during the event window on TSE, RSE and VSE

Day	AAV		
	TSE	RSE	VSE
+5	0.6207	0.0781	-0.1868*
+4	1.0949	-0.0564	-0.1516*
+3	1.3702	-0.2765**	0.8061
+2	2.5721**	-0.3300***	1.0260
+1	3.5878*	0.0464	0.1263
Ex-day	15.1211***	0.5738*	0.4312***
-1	39.4477***	0.2130	0.8641***
-2	3.5432**	0.0324	0.7703
-3	2.3845*	0.1555	0.1413
-4	0.3234**	0.0317	0.1079
-5	0.5269**	-0.0971	-0.1433

Source: compiled by the author
Note: *, **, *** indicate a significance at 10%, 5%, 1%

To conclude, the results of the empirical analysis conducted for Baltic markets were somewhat contradictory. There is a little evidence that stockholders' tax brackets may fully explain ex-dividend day anomaly for the Baltic states. Although, dividend yield was not statistically significant in models for TSE sample and average abnormal trading volumes as a dependent variable, the results might be biased by such extreme extent of trading observed during the event window. In overall, it is quite possible that dividend capturing strategies are implemented on Estonian and Lithuania markets. Yet, the impact of fundamentals on ex-dividend day premiums was negligible if any.

CONCLUSION

The finding that on the ex-dividend day stock prices often decrease by less than a dividend amount instigated many researchers to look for reasons for such a market imperfection. A significant number of studies failed to fully explain the source of the premiums observed on that day. The aim of the thesis was to determine which factors affect Baltic stock prices' behavior on the ex-dividend day and assess the possibility to benefit from it.

There are four main theoretical propositions treated in previous empirical studies that might influence the extent of price adjustment. This thesis focused on the two earliest theories, i.e., tax-induced anomalies and short-term trading. The first theory surmises that price drop is related to difference in tax rates applied to capital gains and dividends. Followers of the second proposition argue that any mispricing driven by marginal investors should be eliminated by short-term traders to the extent of transaction cost for a round-trip.

To answer the first question about the degree of Baltic stocks being affected by the ex-dividend days the mean raw and market-adjusted price-drop ratios and abnormal returns were compared with the values anticipated under perfect capital market assumption. This analysis was complemented by looking into the actual distribution of price drop ratios.

To answer the second question about factors driving abnormal return, the pooled OLS regressions with control for an effect of the global financial crisis were performed. Along such defining factors like dividend yield, risk, transaction costs and, at a lower extent, illiquidity, which are widely examined in the ex-dividend day studies, variables represented by companies' financial ratios were added in the models (ROA, ROE, price-to book, price-to earning, debt-to-asset, debt-to-equity). Another test of tax-induced hypothesis involved comparison of actual price-drop ratios with the ones defined by corporate and individual investors' tax brackets.

Next, stocks' trading volumes on the ex-dividend day and during surrounding 10 days were analyzed to find out if the unusual trading activity might be detected. Finally, the regressions were performed to identify stock features that engage market participants into trading within the event window. Thus, the answer to the third question about investors' awareness of opportunities driven by the phenomenon was obtained.

The empirical analysis revealed, that despite the fact that *on average* stocks traded on Tallinn Stock Exchange (TSE) dropped by almost a dividend amount both during the pre- and post-crisis period actual price-drop ratios were mostly concentrated with the tax burdens during 2000-2005, thus, supporting both the tax-induced and short-term trading hypotheses. Riga stock exchange (RSE) stocks decreased on average by 48% of the dividend amount during the 2000-2007, while Vilnius stock exchange (VSE) by 55%. However, since 2010 the extent of price adjustment increased for both exchanges equaling to 89% for RSE sample and 61% for VSE.

Despite the fact that for TSE transaction costs, expressed both by market capitalization and as a proxy, had an opposite sign of that proposed by arbitrage theory, the regression results showed that abnormal returns increase with risk and decrease with dividend yield, thus supporting short-term trading hypothesis. Out of all fundamental ratios only ROA appeared to be relevant in the model for 2000-2020. The analysis of trading volumes further confirmed that implementation of dividend capturing strategies on TSE is quite likely. On the cum-dividend day and ex-dividend day Estonian stocks volumes were on average 39 and 15 times higher than during the control period. However, the regression analysis for abnormal trading volumes indicated that only leverage and transaction costs were the defining factors, while dividend yield appeared to be insignificant in models. The possible reason that might stand behind such results is that average trading volumes were really extreme and varied a lot between the stocks. According to the models for 2000-2009 and with a minimum price level of 4 euros higher trading volumes might be attributed to the stocks with lower price-to-book ratio.

The results of the analysis undermined for RSE sample were also challenging to interpret. Dividend yields and proxies of risk did not seem to have an effect on abnormal return. The trading volumes on the ex-dividend day were 57% higher than on average for the benchmark period. The estimations show that yield and risk affect trading volumes in the way predicted by dividend-capturing strategy.

There was roughly any factor, but proxy of transaction costs and trading volumes that affected abnormal returns in the way predicted by arbitrage hypothesis on VSE. Although, dividend yield is a significant factor in all three models, the sign was not consistent with the theory. The possible explanation is that results might be biased by stocks with low prices. Still, 86% and 43% higher trading volumes were observed on the cum- and ex-dividend days conforming the dividend capturing. This was further supported by regression analyses.

Time dummy variable for the period 2010-2020 was significant only for TSE sample, showing that since 2010 ex-day abnormal returns increased, while trading volumes decreased. Illiquidity was an important factor that negatively affected premiums both for TSE and VSE samples.

Considering previous discussion there is a little evidence that stock price behavior is defined by tax rates for all three exchanges. It is more likely that investors realize and exploit the anomaly on TSE and VSE in their own favor. The results do not confirm that Latvian stocks are highly attractive from arbitrage perspective. Although, the trading volumes for TSE sample are really extreme, those do not seem to be sufficient to fully eliminate the mispricing. So, considering the preferential taxation of dividends in the Baltic states and that such market makers like LHV and Swedbank do not apply transaction fees for trading Baltic stocks anymore it appears to be possible to benefit from the phenomenon, especially on RSE and VSE.

The main limitation of the analysis is related to the insufficient number of observations making impossible to conduct various test that could shed the light on the anomaly. Such shortcoming could be also responsible for financial ratios appeared to be of a little significance. Another limitation arises from stocks' overall low liquidity, thus, skewing the estimates of average abnormal trading volumes upwards. The foreign exchange rates used in a conversion of dividend amounts stated in local currencies could also affect the results, as Nasdaq could not provide the precise rates applied to historical prices. The current analysis might be extended in future by analyzing the ex-dividend anomaly from the point of market microstructural changes, like moving from tick size to decimalization or how open market orders are treated on the ex-dividend day.

KOKKUVÕTE

EX-DIVIDENDI KUUPÄEVA ANOMAALIA MITTELIKVIIDSETEL TURGUDEL BALTI RIIKIDE NÄITEL

Oksana Neškova

Täiusliku kapitalituru olukorras eeldatakse, et ex-dividendi kuupäeval aktsia hind peab langema ligikaudu dividendi võrra. Selle peamiseks põhjenduseks on, et ettevõtte omakapitali bilansiline väärtus väheneb väljamakstava summa ulatuses. Siiski, on laialdaselt täheldatud, et tegelik hinnalangus on väiksem kui dividend. Sellist aktsiahinna käitumist peetakse tõendiks turu ebatäiuslikkusest.

Empiirilised uurimused käsitlevad peamiselt selliseid suuri turge nagu USA või Suurbritannia, pöörates vähe tähelepanu suhteliselt väikestele ja mittelikviidsetele turgudele. Sellest tulenevalt on antud töö eesmärk välja selgitada, millised tegurid mõjutavad Balti aktsiahindade käitumist ex-dividendi kuupäeval ja hinnata võimalust sellest nähtusest kasu saada. EX-dividendi kuupäeva anomaalia uurimine Eesti, Läti ja Leedu näitel on oluline, sest varasemad uuringud on üksikud ning nüüdseks vananenud, samuti on toimunud muutused maksustamises ning üldised muutused Baltimaade arengus.

Lõputöös üritab autor leida vastuseid järgmistele uurimisküsimustele:

1. Millisel määral ex-dividendi kuupäevad mõjutavad Balti aktsiahindu?
2. Millised ettevõtte finantssuhtarvud lisaks maksude heterogeensusele, riskidele, tehingutasudele ja mittelikviidsusele võivad mõjutada aktsiate ootusi ületavat tootlust?
3. Kas investor on teadlik ja kasutab ära sellise turu puudujäägi tõttu tekkinud võimaluse anomaalia olemasolu korral?

Esimese teooria kohaselt määratletakse investorite dividendidele hinnalanguse määr ja väärtpaberi võõrandamisest saadud kasumile maksumäär. Arvestades ülaltoodud väidet, kui aktsia hind langeb ex-dividendi kuupäeval rohkem kui dividend, peaks see näitama, et aktsionäril on saadava dividendi suhtes maksueelne kohtlemine. Teise teooria vastuväited on, et selline maksudest põhjustatud väärhindamine peab olema kõrvaldatud hangeldajate poolt kuni edasi-tagasi tehingukulude ulatuseni. Järgmine populaarne teooria toob välja selliste turu mikrostruktuuriliste karakteristikute mõju aktsiate käitumisele nagu hinnasamba suurus ja turuorderite kohandamise reeglid. Antud töö raames käsitletakse kaks esimest teooriat.

Uurimuses kasutatud andmed koguti peamiselt kahest allikast: Nasdaq Baltic ja ettevõtete finantsaruanded. Lõputöö ülesannete saavutamiseks kasutatud metoodika on sündmusuuring koos regressioonanalüüsiga kasutades EViews11 tarkvara. Valim sisaldab Eesti, Läti ja Leedu ettevõtteid, mis olid noteeritud Nasdaq Balti börside põhi- ja lisanimekirjades ning maksid aastatel 2000-2020 dividende. Periood on piisavalt pikk, et uurida, kuidas mõjutas ülemaailmne finantskriis Balti aktsiate käitumist dividendipäevadel.

Empiirilisest analüüsist selgus, et hoolimata asjaolust, et Tallinna börsil (TSE) kaubeldavad aktsiad langesid nii kriisieelsel kui ka -järgsel perioodil keskmiselt peaaegu dividendide võrra, tegelike hinnalanguste suhtarvude koondumine aastatel 2000–2005 toetas maksudest tingitud teooriat. Siiski lühiajaline kauplemine võis mõjutada ka seda perioodi, kuna maksustatavat baasi oli võimalik vähendada väärtpaberite võõrandamise tagajärjel tekkinud kahjumi ulatuses, sõltumata hoidmisperioodist. Riia börsi (RSE) aktsiad langesid aastatel 2000-2007 keskmiselt 48% dividendide summast, Vilniuse börsi (VSE) omad aga 55% ulatuses. Kuid alates 2010. aastast kasvas mõlema börsi hinnalangus ulatudes 89% RSE ja 61% VSE puhul.

Hoolimata asjaolust, et tehingukulud olid vastupidise märgiga, näitasid regressioonitulemused, et ootusi ületav tootlus suureneb koos riskiga ja väheneb koos dividenditootlusega, toetades seega lühiajalist kauplemishüpoteesi. Kõigist finantssuhtarvudest 2000–2020 mudeli jaoks osutus statistiliselt oluliseks ainult ROA. Kauplemismahtude analüüs kinnitas veelgi, et dividendide hõivamise strateegiate rakendamine TSE-l on üsna tõenäoline. Ex-dividendi ja sellele eelneval kuupäevadel olid Eesti aktsiate mahud keskmiselt 39 ja 15 korda suuremad kui kontrollperioodil. Ootusi ületav kauplemismahtude regressioonanalüüs näitas, et määravateks teguriteks osutusid ainult finantsvõimendus ja tehingukulud, samas kui dividenditootlus näis mudelites ebaoluline. Võimalik põhjus, mis võib selliste tulemuste taga seista, on see, et keskmised kauplemismahud olid äärmuslikud ja varieerusid palju. Aastate 2000-2009 mudelite kohaselt ja minimaalselt 4-eurose aktsiahinnaga võib suurema kauplemismahu omistada madalama turuhinna-raamatupidamisväärtuse suhtarvuga aktsiatele.

RSE valimi analüüsi tulemused olid samuti vaieldavad. Osutus, et dividenditootlus ja risk ei mõjutanud ootusi ületavat tootlust. Ex-dividendi kuupäeva kauplemismahud olid 57% võrra kõrgemad kui keskmiselt võrdlusperioodil 10% -nivool. Kuid dividenditootlus ja risk mõjutavad kauplemismahte dividendide hõivamise strateegia kohaselt.

Ja jällegi, seal oli väga väheseid faktoreid peale tehingutasude ja -mahtude, mis omasid mõju ootusi ületavatele tootlustele viisil, mida ennustas arbitraažitegevus VSE-l. Ehkki dividenditootlus on kõigi kolme mudeli puhul oluline tegur, ei olnud liikumineteooriaga kooskõlas. Võimalikuks põhjuseks on, et madala hinnaga aktsiad võivad tulemusi kallutada. Sellegipoolest täheldati 86% ja 43% suuremat kauplemismahtu dividendide hõivamisele vastavate kumulatiivsete ja ex-dividendi kuupäevadel. Seda toetasid edasi ka regressioonanalüüsid.

Ajaline fiktiivne muutuja oli märkimisväärne ainult TSE valimi puhul, mis näitas, et alates 2010. aastast kasvas ootusi ületav tootlus, samas kui kauplemismaht vähenes. Likviidsus oli oluline tegur, mis mõjutas negatiivselt preemiat nii TSE kui ka VSE valimi puhul.

Eelnevat arutelu arvestades on vähe tõendeid selle kohta, et kolme börsi aktsiahindade käitumine on määratletud puhtalt maksumääradega. On aga tõenäolisem, et investorid mõistavad ja kasutavad TSE ja VSE anomaaliat enda kasuks ära. Tulemused ei kinnita, et Läti aktsiad oleksid arbitraaži seisukohast atraktiivsed. Ehkki TSE valimi kauplemismahud on tõesti äärmuslikud, ei ole need valehindamise täielikuks kõrvaldamiseks piisavad. Nii et arvestades Balti riikide dividendide eelismaksustamist ja seda, et sellised turutegijad nagu LHV ja Swedbank ei rakenda enam Balti aktsiatega kauplemisel tehingutasusid, näib, et nähtusest on võimalik kasu saada, eriti RSE-l ja VSE-l.

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APPENDICES

Appendix 1. Excluded ex-dividend events

	Exchange		
Restriction	TSE	RSE	VSE
Irregularity	7	12	9
Extraordinary dividend or other pay-outs	16	7	5
Dividends near other pay-outs	5	1	1
Dividend less than 0.01 euro	-	10	41
No information about prices, volumes	2	5	-
Inadequate daily price changes (benchmark, event window)	5	2	-
Requirements for volumes not fulfilled	7	74	21
Financial institutions	9	3	20
No information about financials for at least two years	-	3	14

Source: compiled by the author

Appendix 2. Correlation Matrix for TSE sample (2000-2020)

	ARISK	D/A	D/E	FRISK	log(ILLIQ)	log(MCAP)	P/B	P/E	ROA	ROE	TRCOST	log(VOL)	YIELD
ARISK	1.000	-0.030	-0.024	0.937	0.045	-0.283	-0.005	-0.011	-0.095	-0.085	0.144	-0.200	-0.142
D/A	-0.030	1.000	0.973	-0.025	0.151	0.009	-0.179	0.039	-0.534	-0.284	0.250	-0.168	-0.148
D/E	-0.024	0.973	1.000	-0.003	0.126	-0.044	-0.154	0.006	-0.511	-0.265	0.249	-0.160	-0.157
FRISK	0.937	-0.025	-0.003	1.000	0.055	-0.439	-0.090	-0.013	-0.149	-0.123	0.220	-0.281	-0.218
log(ILLIQ)	0.045	0.151	0.126	0.055	1.000	0.076	-0.137	0.050	-0.203	-0.168	0.139	-0.701	-0.006
log(MCAP)	-0.283	0.009	-0.044	-0.439	0.076	1.000	0.490	-0.066	0.302	0.309	-0.339	0.407	0.253
P/B	-0.005	-0.179	-0.154	-0.090	-0.137	0.490	1.000	-0.005	0.486	0.530	-0.487	0.150	0.004
P/E	-0.011	0.039	0.006	-0.013	0.050	-0.066	-0.005	1.000	-0.171	-0.174	0.206	-0.116	-0.191
ROA	-0.095	-0.534	-0.511	-0.149	-0.203	0.302	0.486	-0.171	1.000	0.885	-0.424	0.330	0.308
ROE	-0.085	-0.284	-0.265	-0.123	-0.168	0.309	0.530	-0.174	0.885	1.000	-0.453	0.218	0.248
TRCOST	0.144	0.250	0.249	0.220	0.139	-0.339	-0.487	0.206	-0.424	-0.453	1.000	-0.045	-0.366
log(VOL)	-0.200	-0.168	-0.160	-0.281	-0.701	0.407	0.150	-0.116	0.330	0.218	-0.045	1.000	0.334
YIELD	-0.142	-0.148	-0.157	-0.218	-0.006	0.253	0.004	-0.191	0.308	0.248	-0.366	0.334	1.000

Source: compiled by the author

Appendix 3. Correlation Matrix for TSE sample (2000-2009)

	ARISK	D/A	D/E	FRISK	log(ILLIQ)	log(MCAP)	P/B	P/E	ROA	ROE	TRCOST	log(VOL)	YIELD
ARISK	1.000	0.133	0.121	0.950	0.179	-0.265	-0.072	0.129	-0.221	-0.131	0.426	-0.269	-0.043
D/A	0.133	1.000	0.985	0.172	-0.002	-0.126	-0.047	0.129	-0.399	-0.074	0.168	-0.226	-0.264
D/E	0.121	0.985	1.000	0.167	-0.013	-0.097	-0.013	0.110	-0.401	-0.045	0.147	-0.201	-0.259
FRISK	0.950	0.172	0.167	1.000	0.125	-0.404	-0.163	0.055	-0.292	-0.158	0.425	-0.305	-0.081
log(ILLIQ)	0.179	-0.002	-0.013	0.125	1.000	0.183	0.033	-0.047	-0.051	-0.024	0.103	-0.762	0.043
log(MCAP)	-0.265	-0.126	-0.097	-0.404	0.183	1.000	0.643	0.117	0.466	0.375	-0.473	0.238	0.064
P/B	-0.072	-0.047	-0.013	-0.163	0.033	0.643	1.000	0.452	0.320	0.365	-0.484	0.023	-0.273
P/E	0.129	0.129	0.110	0.055	-0.047	0.117	0.452	1.000	-0.135	-0.135	-0.067	-0.010	-0.291
ROA	-0.221	-0.399	-0.401	-0.292	-0.051	0.466	0.320	-0.135	1.000	0.811	-0.402	0.271	0.173
ROE	-0.131	-0.074	-0.045	-0.158	-0.024	0.375	0.365	-0.135	0.811	1.000	-0.377	0.054	-0.063
TRCOST	0.426	0.168	0.147	0.425	0.103	-0.473	-0.484	-0.067	-0.402	-0.377	1.000	-0.111	-0.003
log(VOL)	-0.269	-0.226	-0.201	-0.305	-0.762	0.238	0.023	-0.010	0.271	0.054	-0.111	1.000	0.341
YIELD	-0.043	-0.264	-0.259	-0.081	0.043	0.064	-0.273	-0.291	0.173	-0.063	-0.003	0.341	1.000

Source: compiled by the author

Appendix 4. Correlation Matrix for TSE sample (2010-2020)

	ARISK	D/A	D/E	FRISK	log(ILLIQ)	log(MCAP)	P/B	P/E	ROA	ROE	TRCOST	log(VOL)	YIELD
ARISK	1.000	0.031	0.050	0.918	0.032	-0.309	-0.279	-0.003	-0.290	-0.347	0.250	-0.182	-0.237
D/A	0.031	1.000	0.967	-0.023	0.084	0.056	-0.014	-0.020	-0.464	-0.210	0.117	-0.066	-0.009
D/E	0.050	0.967	1.000	0.039	0.037	-0.065	0.011	-0.057	-0.428	-0.187	0.130	-0.079	-0.049
FRISK	0.918	-0.023	0.039	1.000	0.086	-0.526	-0.385	0.006	-0.321	-0.406	0.384	-0.314	-0.389
log(ILLIQ)	0.032	0.084	0.037	0.086	1.000	-0.104	-0.166	0.073	-0.160	-0.129	-0.001	-0.631	0.012
log(MCAP)	-0.309	0.056	-0.065	-0.526	-0.104	1.000	0.481	-0.136	0.279	0.362	-0.393	0.611	0.476
P/B	-0.279	-0.014	0.011	-0.385	-0.166	0.481	1.000	-0.164	0.599	0.696	-0.571	0.347	0.497
P/E	-0.003	-0.020	-0.057	0.006	0.073	-0.136	-0.164	1.000	-0.182	-0.203	0.227	-0.169	-0.200
ROA	-0.290	-0.464	-0.428	-0.321	-0.160	0.279	0.599	-0.182	1.000	0.923	-0.301	0.379	0.421
ROE	-0.347	-0.210	-0.187	-0.406	-0.129	0.362	0.696	-0.203	0.923	1.000	-0.400	0.381	0.576
TRCOST	0.250	0.117	0.130	0.384	-0.001	-0.393	-0.571	0.227	-0.301	-0.400	1.000	0.044	-0.575
log(VOL)	-0.182	-0.066	-0.079	-0.314	-0.631	0.611	0.347	-0.169	0.379	0.381	0.044	1.000	0.317
YIELD	-0.237	-0.009	-0.049	-0.389	0.012	0.476	0.497	-0.200	0.421	0.576	-0.575	0.317	1.000

Source: compiled by the author

Appendix 5. Correlation Matrix for TSE sample (2000-2020, excluding 2007Q3-2009Q4)

	ARISK	D/A	D/E	FRISK	log(ILLIQ)	log(MCAP)	P/B	P/E	ROA	ROE	TRCOST	log(VOL)	YIELD
ARISK	1.000	-0.018	-0.018	0.919	-0.060	-0.258	0.094	0.024	-0.088	-0.088	0.103	-0.142	-0.217
D/A	-0.018	1.000	0.973	-0.014	0.174	-0.003	-0.171	0.033	-0.521	-0.288	0.246	-0.196	-0.112
D/E	-0.018	0.973	1.000	0.008	0.149	-0.055	-0.146	-0.003	-0.497	-0.270	0.249	-0.186	-0.126
FRISK	0.919	-0.014	0.008	1.000	-0.057	-0.438	0.007	0.025	-0.139	-0.123	0.184	-0.239	-0.319
log(ILLIQ)	-0.060	0.174	0.149	-0.057	1.000	0.103	-0.062	0.069	-0.203	-0.148	0.097	-0.693	-0.003
log(MCAP)	-0.258	-0.003	-0.055	-0.438	0.103	1.000	0.490	-0.077	0.287	0.304	-0.341	0.393	0.283
P/B	0.094	-0.171	-0.146	0.007	-0.062	0.490	1.000	-0.017	0.473	0.531	-0.466	0.095	-0.003
P/E	0.024	0.033	-0.003	0.025	0.069	-0.077	-0.017	1.000	-0.172	-0.171	0.231	-0.132	-0.187
ROA	-0.088	-0.521	-0.497	-0.139	-0.203	0.287	0.473	-0.172	1.000	0.895	-0.413	0.323	0.271
ROE	-0.088	-0.288	-0.270	-0.123	-0.148	0.304	0.531	-0.171	0.895	1.000	-0.460	0.198	0.227
TRCOST	0.103	0.246	0.249	0.184	0.097	-0.341	-0.466	0.231	-0.413	-0.460	1.000	-0.021	-0.391
log(VOL)	-0.142	-0.196	-0.186	-0.239	-0.693	0.393	0.095	-0.132	0.323	0.198	-0.021	1.000	0.348
YIELD	-0.217	-0.112	-0.126	-0.319	-0.003	0.283	-0.003	-0.187	0.271	0.227	-0.391	0.348	1.000

Source: compiled by the author

Appendix 6. Correlation Matrix for RSE sample (2000-2020)

	ARISK	D/A	D/E	FRISK	log(ILLIQ)	log(MCAP)	P/B	P/E	ROA	ROE	TRCOST	log(VOL)	YIELD
ARISK	1.000	-0.166	-0.087	0.930	0.128	-0.066	-0.040	-0.159	-0.336	-0.323	0.240	-0.055	0.279
D/A	-0.166	1.000	0.945	-0.129	-0.203	-0.157	-0.007	0.122	-0.087	0.089	0.232	0.029	-0.395
D/E	-0.087	0.945	1.000	-0.071	-0.241	-0.208	-0.015	0.100	-0.111	0.062	0.337	0.101	-0.326
FRISK	0.930	-0.129	-0.071	1.000	0.008	-0.254	-0.146	-0.152	-0.399	-0.388	0.347	0.041	0.328
log(ILLIQ)	0.128	-0.203	-0.241	0.008	1.000	0.601	-0.078	-0.045	-0.067	-0.102	-0.303	-0.840	0.196
log(MCAP)	-0.066	-0.157	-0.208	-0.254	0.601	1.000	0.298	-0.033	0.199	0.173	-0.691	-0.357	-0.093
P/B	-0.040	-0.007	-0.015	-0.146	-0.078	0.298	1.000	0.267	0.431	0.394	-0.313	0.049	-0.313
P/E	-0.159	0.122	0.100	-0.152	-0.045	-0.033	0.267	1.000	-0.069	-0.098	0.097	0.002	-0.462
ROA	-0.336	-0.087	-0.111	-0.399	-0.067	0.199	0.431	-0.069	1.000	0.967	-0.380	-0.058	-0.422
ROE	-0.323	0.089	0.062	-0.388	-0.102	0.173	0.394	-0.098	0.967	1.000	-0.349	-0.054	-0.458
TRCOST	0.240	0.232	0.337	0.347	-0.303	-0.691	-0.313	0.097	-0.380	-0.349	1.000	0.222	-0.031
log(VOL)	-0.055	0.029	0.101	0.041	-0.840	-0.357	0.049	0.002	-0.058	-0.054	0.222	1.000	0.024
YIELD	0.279	-0.395	-0.326	0.328	0.196	-0.093	-0.313	-0.462	-0.422	-0.458	-0.031	0.024	1.000

Source: compiled by the author

Appendix 7. Correlation Matrix for VSE sample (2000-2020)

	D/A	D/E	log(ILLIQ)	log(MCAP)	P/B	P/E	ARISK	FRISK	ROA	ROE	TRCOST	log(VOL)	YIELD
D/A	1.000	0.955	-0.113	-0.220	0.150	0.083	0.026	0.017	-0.065	0.154	-0.193	-0.199	-0.320
D/E	0.955	1.000	-0.124	-0.272	0.115	0.046	0.085	0.063	-0.066	0.165	-0.182	-0.192	-0.306
log(ILLIQ)	-0.113	-0.124	1.000	0.395	-0.011	0.047	0.223	0.277	-0.213	-0.272	0.132	-0.505	0.277
log(MCAP)	-0.220	-0.272	0.395	1.000	0.294	0.348	-0.169	-0.235	-0.134	-0.256	0.051	0.236	0.190
P/B	0.150	0.115	-0.011	0.294	1.000	0.723	-0.169	-0.157	0.155	0.186	-0.305	-0.093	-0.157
P/E	0.083	0.046	0.047	0.348	0.723	1.000	0.020	0.010	0.020	0.025	-0.276	-0.152	-0.210
ARISK	0.026	0.085	0.223	-0.169	-0.169	0.020	1.000	0.938	-0.141	-0.094	0.070	-0.341	0.061
FRISK	0.017	0.063	0.277	-0.235	-0.157	0.010	0.938	1.000	-0.174	-0.129	0.047	-0.430	0.096
ROA	-0.065	-0.066	-0.213	-0.134	0.155	0.020	-0.141	-0.174	1.000	0.929	-0.185	0.027	-0.060
ROE	0.154	0.165	-0.272	-0.256	0.186	0.025	-0.094	-0.129	0.929	1.000	-0.278	-0.059	-0.170
TRCOST	-0.193	-0.182	0.132	0.051	-0.305	-0.276	0.070	0.047	-0.185	-0.278	1.000	0.352	0.158
log(VOL)	-0.199	-0.192	-0.505	0.236	-0.093	-0.152	-0.341	-0.430	0.027	-0.059	0.352	1.000	0.140
YIELD	-0.320	-0.306	0.277	0.190	-0.157	-0.210	0.061	0.096	-0.060	-0.170	0.158	0.140	1.000

Source: compiled by the author

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