



## Day of the week effect and Baltic stock exchanges

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### ABSTRAKT

**Objective:** There is an ongoing debate in the field of finance and economics on the existence of abnormal equity returns associated with calendar events. Commentaries including tax-loss selling at year-end, cash flows at month-end and negative news flow over the weekend give convincing evidence in support of returns abnormalities. In the mainstream markets (sector and geography wise) the topic of calendar anomalies was heatedly debated by industry participants and academics. Baltic bourses, however, received less attention. Given the gap, this current research was set to examine daily variations in the performance of the NASDAQ Baltic series.

**Research Design & Methods:** A well-established parametric algorithm was employed to test whether variations in returns are statistically different throughout week. Dummy-variable regression with an additional set of dummies that controlled for outliers in the series was performed.

**Findings:** The study found no evidence in support of the day-of-the-week in four NASDAQ Baltic series. However, Thursday and Friday came out as being positive and significant in Vilnius and Riga series.

**Contribution & Value Added:** The paper adds additional evidence on the contested issue of calendar anomalies. Certainly, differentials achieved on Thursday or Friday would not generate abnormal returns for institutional or individual investor. However, investors could use this updated knowledge to trade more effectively.

**Typ artykułu:** research paper

**Słowa kluczowe:** Stocks; Baltic; Market; Returns; Monday

**Kody JEL:** C22, G14, G20

Received: 11 August 2017

Accepted: 6 June 2018

### Suggested citation:

Jadevicius, A. (2018). Day of the week effect and Baltic stock exchanges. *International Entrepreneurship Review* (previously published as *Przedsiębiorczość Międzynarodowa*), 4(2), 31-41. <https://doi.org/10.15678/PM.2018.0402.02>

### INTRODUCTION

Finance nowadays is a fundamental facet of any modern society. Certainly, the reputation of the financial industry has been tarnished over the recent years with misconducts such as PPI and Libor hitting the headlines. However, drawing from history, economic theory,

and general observations, a Nobel-winning economist Shiller (2012) argues that these adverse occurrences notwithstanding, finance is one of the most powerful ‘technologies’ advancing the general well-being. Finance, as Ferguson (2009) remarks, enables businesses and individuals achieve heights they wouldn’t achieve otherwise. These include pensions and savings, credits for businesses and individual, mortgages, to name but a few.

A very special role in finance belongs to stock markets. One probably cannot imagine modern society without a well-functioning stock exchange. Myanmar (Burma), a south-East Asian nation, which recently opened itself to world markets after the decades under the military rule, opened its own stock exchange marking a rapid step in its modernisation.

Since its humble beginning in 16th century Belgium there were many steps along the road to what we know as a modern stock exchange (Smith, 2001; 2004). What was traditionally a club of brokers and moneylenders who exchanged bonds and securities under a buttonwood tree (Siegel, 2014), nowadays stock exchanges are fully automated establishments with trades being executed electronically therefore enabling a greater participation among various investor types (Lewis, 2015).

The democratisation of the stock market certainly benefited various investor types. However, it is paramount to remember that investing is generally considered as a risky and uncertain business (Graham and Dodd, 1940; Philip, 1996; Mallaby, 2011). It is afflicted with systemic and idiosyncratic risks. As such, to mitigate their exposure and enhance profits, investors began refining their investment strategies.

An interesting approach in trading is so called market arbitrage. This strategy relies on mining securities which are priced differently at the same point of time in different markets and then taking advantage of this discrepancy (Kahneman, 2012; Thaler, 2015). Certainly, this strategy goes against the so called Efficient Market Hypothesis (EMH) (Fama et al., 1969; Malkiel & Fama, 1970; Shiller, 1981) and has resulted in some of the largest financial calamities in history (Lowenstein, 2001). However, by recognising that securities can behave differently an investor can achieve superior returns.

One of the temporarily differences in securities relates to so called day of the week effect. The theorem states that certain days-of-the-week perform better/worse than others (Fama, 1965; Godfrey et al., 1964; French, 1980). This anomaly has been heatedly debated with researchers providing evidence for against this phenomenon. Likewise, the hypothesis has been tested on international bourses. However, to the best of the author’s knowledge there were no prior studies considered the day of the week effect in the Baltic Stock exchange. Given the gap, the current study examines whether daily returns differ on Riga, Tallinn and Vilnius stock exchanges and what it entails to an investor.

The remainder of this paper is structured as follows. Section 2 reviews previous studies on calendar anomalies in common stocks. The data are presented in Section 3. Section 4 presents the results. The final part concludes the study.

## PREVIOUS STUDIES

### Day of the week effect

It is generally agreed that Bachelier (1900, cited in Davis and Etheridge, 2006) was the first to recognise calendar related irregularities in equity returns. The key thesis of Bachelier’s

work circled around the process of information flow continuum. In other words, he hypothesised whether stock returns operate continuously or only during active trading. According to French (1980), Bachelier asserted that with equities being traded throughout Monday to Friday and returns being generated continuously in calendar time, each day of the week is likely to generate different fortunes and vice versa. Bachelier's hypothesis that each weekday can be characterised by contrasting fortunes subsequently attracted a notable following with the likes of Fama (1965), Clark (1973), Brown and Warner (1985), French and Roll (1986), Gallant et al. (1992), and Thaler (2012).

The premise of the calendar anomaly and the fact that it can provide with an arbitrage opportunity contradicts the very essence of efficient market hypothesis (EMH). According to EMH, financial markets are information efficient. Day-to-day price changes of common stocks are assumed to follow random walk cancelling any prospects of profiting from past information (Fama et al., 1969). As such, prices of traded assets are well known in advance (Maier and Herath, 2009) and therefore investors cannot gain advantage in predicting future direction of these assets using publically available information (Cho et al., 2007).

Cho et al. (2007) however noted four compelling arguments for and against the day-of-the-week axiom. First, there is an issue of data-snooping – if a right procedure is applied to control for a calendar anomaly it disappears. Second, market microstructure, that ties to market settlements, dividends and taxes that can drive discrepancies in trading. Third, information flow during the week that has an effect on trading volumes. Fourth, trading itself – previous studies have shown that individual investors take riskier bets on Fridays than on Mondays (Miller, 1988; Pettengill, 1993).

With these arguments in hand, the day-of-the-week have become a subject of extensive research programme among various listed asset classes and internationally. Industry commentators and scholars provided with a myriad of commentary for and against this anomaly with few conclusions being drawn.

### **Baltic stock exchange commentaries**

Since their renaissance in later 1990s, Baltic bourses attracted a notable research attention from academics and practitioners and that despite them being at the periphery of the global financial network. Coupled with an ever increasing data availability, commentators looked into macro-determinants of stock market returns, volatility and performance (Kairys Jr. et al., 2000; Maciulis et al., 2007; Laidroo, 2008; Aktan et al., 2010), their link to bigger sister bourses (Maneschiöld, 2006; Nielsson, 2007; Deltuvaite, 2015) and of course an impact of the global financial crisis of 2008 (Masood et al., 2010; Nikkinen, 2012).

However, to the best of authors knowledge a limited research was carried out on the topic of daily trading in the Baltic stock exchange. The only study that looked into the issue of daily trading is that of Sakalauskas and Kriksciuniene (2007). In their paper commentators examined Vilnius Stock OMX selected equities daily performance by grouping equities into so called turnover buckets. Their non-parametric estimates were in support of day-of-the-week effect. Although the authors concluded that this phenomenon is phasing, a similar tendency observed in mature markets.

Given the gap this current study re-examines the day-of-the-week phenomenon. It advances Sakalauskas and Kriksciuniene's (2007) study in three ways. First, study looks into all three Baltic bourses rather than just concentrating on Vilnius stock exchange. Second, the study employs dummy variable regression as an alternative (and more superior) technique

to test for day-of-the-week effect. Finally, study presents with practical implications for investors, something that was missed in previous commentaries on the subject.

## DATA

### Historical background

The study uses daily returns series for four NASDAQ OMX Baltic market indices: OMX Baltic Benchmark GI (OMXBBGI), OMX Tallinn (OMXT), OMX Riga (OMXR) and OMX Vilnius (OMXV). Series start from 03 January 2000 when a joint list of securities listed on the Baltic Stock Exchanges was announced (NASDAQ Baltic, 2016a). Although, origins of three sister exchanges can be traced back to early 20th century.

Estonia was a pioneer of the clearing houses in the region. In 1920 it's government launched a foreign currency and securities exchange, a predecessor to Tallinn Stock Exchange. Securities were traded on the last day of the year by clearing bank representatives. Since March 1934 frequency increased to monthly quotations. Unfortunately, trading halted in 1941 with the Soviet Occupation of the Republic (NASDAQ Baltic, 2016b).

Early 1990s saw a resurrection of the clearing houses in the region. After its independence, Estonian government embarked into creating a new securities market from virtually zero. This followed significant changes in legislative framework, as well as IT infrastructure needed for a modern stock exchange (NASDAQ Baltic, 2016b). Lithuania and Latvia were following suit soon after. In 1992 Lithuania passed the resolution on the Establishment of the Securities Commission and the National Stock Exchange. The following year, it saw its first trading (NASDAQ Baltic, 2016c). December the 7th 1993 is generally accepted as an official starting day of the Riga Stock Exchange. Both Vilnius and Riga bourses borrowed the platform donated by the Paris Stock Exchange (NASDAQ Baltic, 2016c).

The next significant step in the development of the Baltic Stock Exchange came in at early 2000s. This period is characterised by an ever closer integration among three Baltic exchanges, increasing menu of products and services on offer, as well as their recognition internationally.

In April 2001, Finland's HEX Group acquired majority of the Tallinn Stock Exchange Group with the latter starting to trade in the HEX trading system. The following year, Estonian parliament passed Securities Market Act harmonising Estonian legislation and regulation with the EU's legal framework.

Following on from this, the HEX Group became the main shareholder of the RSE. The former then merged with OM Group (Sweden), creating the OMX Group – a leading market services and solutions provider in global financial and energy markets.

Three Baltic bourses also joined forces together creating the list of securities listed on the Baltic Stock Exchanges – further step in co-integrating three clearing houses. In addition to that three stock exchanges gained a greater appreciation internationally. The TSE adopted so called SAXESS Nordic-Baltic trading platform used by sister exchanges in Sweden, Denmark, Iceland, Finland and Latvia. Lithuania adopted the same trading system in 2005 after becoming part of OMX through privatization. VSE also became a member of World Federation of Exchanges (WFE) the same year.

Two years after the Baltic exchange introduced a single Baltic membership further strengthening the link between three bourses. In 2008 NASDAQ and OMX NASDAQ console-

dated to become NASDAQ OMX Group, Inc subsequently converging all three clearing houses into one unit. The same year NASDAQ OMX Vilnius marked its 15th anniversary.

The history of all three Baltic stock exchanges is a great exemplar of national strive to have an independent and thriving financial sector. All three nations early recognised that a well-functioning financial sector with clearing houses being at the core of it is paramount for any sovereign. What was a humble start and a desire to create national clearing houses produced a leading platform in the region allowing investors, retail and institutional, broaden their securities allocations as well as increase market efficiency and cut associated investment risks.

### Dependent series

Table 1 below presents with the series summary statistics. Figure 1 charts average daily returns distribution for four selected series. The cursory series examination suggests that the average returns series posted is rather humble averaging around 0.05 per cent per day over the entire research period. Certainly, there were periods of notable price appreciations in the series, same as notable corrections especially during the global financial crisis. Of all three stock exchanges Tallinn index was the most generous to its investors. Vilnius, on the other hand, was the least rewarding. However, all in all, returns were modest when taken as a whole for all three stock exchanges.

A visual analysis of the daily returns draws an immediate attention to Monday. Monday, clearly lags behind other days of the week in terms of realised returns. Friday, on the other hand, generates greatest returns compared to other weekdays (Figure 1 and Figure 2). For Riga and Vilnius Monday returns are even negative providing prima facie support for the day-of-the-week effect.

**Table 1. Series summary statistics (1 January 2000 – 30 December 2016)**

Summary stats	OMXBBGI (%)	OMXT (%)	OMXR (%)	OMXV (%)
Average	0.052	0.056	0.056	0.044
St.Dev	0.974	1.107	1.418	1.018
Range	17.820	19.660	25.980	22.880
Min	-8.440	-6.800	-13.680	-11.250
Max	9.380	12.860	12.300	11.630
N	4344	4344	4344	4344

Source: own study.

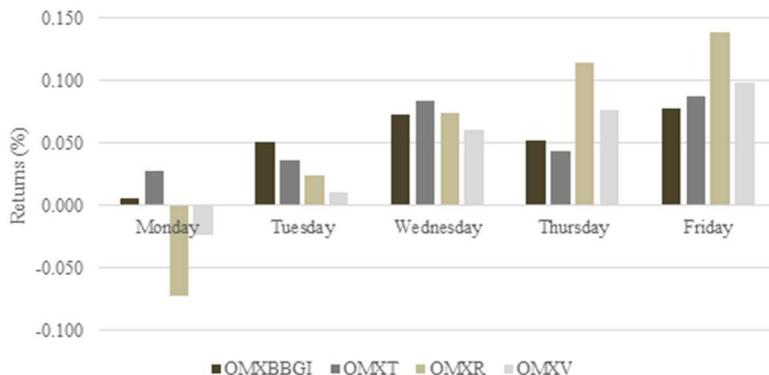
### METHODOLOGY

To study the potential calendar effects on daily returns, a well-established regression analysis is employed. It comes in the form of the following equation where the joint significance of parameters  $D_2$  to  $D_5$  is examined:

$$R_t = \alpha_1 + \alpha_2 D_{2,t} + \alpha_3 D_{3,t} + \alpha_4 D_{4,t} + \alpha_5 D_{5,t} + \alpha_6 D_{out,t} + R_{t-1} + \varepsilon_t \quad (1)$$

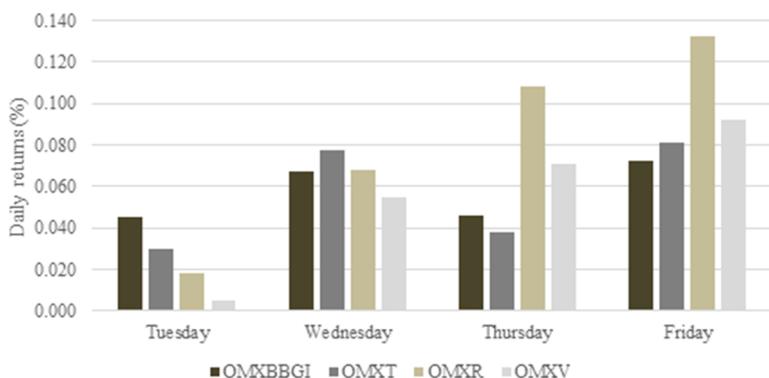
Here  $R_t$  is the daily continuously index returns,  $D_2$  to  $D_5$  denote dummy variables for Tuesday to Friday. The constant parameter  $\alpha_1$  is the average return for Monday, and the coefficient estimates  $\alpha_2$  to  $\alpha_5$  represent the differences between Monday returns and the re-

turns in other days and  $\varepsilon_t$  is the error term. If returns for each day of the year are the same, the parameters  $\alpha_2$  to  $\alpha_5$  should be jointly insignificant.



**Figure 1. Average daily returns (1 January 2000 – 30 December 2016)**

Source: NASDAQ Baltic (2017).



**Figure 2. Difference in returns compared to Monday (1 January 2000 – 30 December 2016)**

Source: NASDAQ Baltic (2017).

With the effect of calendar anomalies attracting attention of practitioners and academics aiming to benefit from possible arbitrage opportunities, any significant calendar anomaly may be violated if results are driven by only a few outliers (Maberly and Pierce, 2004; Bouman and Jacobsen, 2002; Taleb, 2008). In order to control for outliers, a series of dummies are inserted into the equation. Dummy one is for minimum value for Monday. Dummy two and three are maximum values for Tuesday and Wednesday.

In addition to that, series residuals are tested for serial correlation. The caveat of series correlations is that their presence invalidates standard assumptions of regression leading to inaccurate estimates. To mitigate a possible occurrence of serial correlation, general Breusch (1978) – Godfrey (1978) test for serial correlation in the residuals is computed (Hatemi-J, 2004). Additionally, an AR(1) term is introduced into the equation in the form of  $R_{t-1}$ .

Before regression is performed, all series are tested for stationarity. The estimates for a unit-root are presented in Table 2 below.

**Table 2. Unit-root test results**

Series	Test results for NASDAQ series			
	ADF	DF-GLS <sup>1</sup>	PP	ERS <sup>2</sup>
OMXBBGI (%)	-57.499	-0.424	-61.981	1.172
OMXT (%)	-58.352	-0.380	-61.084	1.770
OMXR (%)	-32.937	-1.267	-64.232	0.119
OMXV (%)	-18.672	-0.515	-64.320	0.051

Note: The test critical values (significance is at 1, 5 and 10 percent level) are as follows:

1) Augmented Dickey-Fuller (ADF) test: -3.432; -2.862; -2.567.

2) Dickey-Fuller GLS (ERS) test: -2.565; -1.941; -1.617.

3) Phillips-Peron (PP) test: -3.432; -2.862; -2.567.

4) Elliott-Rothenberg-Stock (ERS) test: 1.990; 3.260; 4.480.

1 MacKinnon (1991, p.275)

2 Elliott-Rothenberg-Stock (1996, p.825)

Source: own study.

## RESULTS

The two tables below present with regression estimates for each MASDAQ Baltic index. Table 3 illustrates simplified regression estimates that are based on the dummy variables for each day of the week only. Table 4 contains extended modelling results with the inference of outliers as well as autoregressive component.

As the overall results suggest, there is very little evidence of the day-of-the-week effect in NASDAQ Baltic series. The intercept for the aggregate OMXBBGI index is positive and insignificant. Regression coefficients for Tuesday, Wednesday, Thursday and Friday are also above significance threshold. Neither of regional indices have their regression estimates significant either. In case of Riga and Vilnius indices, their intercepts are below 0, however, insignificant. These estimates reaffirm that although returns on Mondays tend to lag returns achieved during the rest of the week, and in case of Vilnius and Riga returns on aggregate are negative, all in all Baltic stock markets do not exhibit day-of-the-week effect. A closer regression estimates scrutiny presented in table 4 provides with the same verdict. Whether it is aggregate OMXBBGI index or regional Tallinn, Riga and Vilnius series, regression result reject the day-of-the-week hypothesis.

However, with the overall hypothesis being rejected, some useful details emerge. One of those is positive returns achieved on Thursday in Riga and significant estimates for Friday in Riga and Vilnius. Both days come out as being significant in two data-sets – with and without additional statistical inference – allowing to hypothesise that the Vilnius and Riga indices exhibit stronger returns towards the end of the week.

Thought significant, the absolute returns differences are modest for investors to gain superior returns when trading daily in the NASDAQ Baltic. As it is seen from the Figure 3 below, the maximum investor can gain is 0.133% by selling on Friday Riga index or 0.108% selling index on Thursday. The overall NASDAQ index returns differentials vary from 0.045% on Tuesday to 0.072% on Friday. In Tallinn Tuesday is on average 0.030% and Friday is 0.081% above Monday levels. In Vilnius, Tuesday is up by 0.005% and Friday 0.092% compared to Monday levels. This is certainly enough to offset trading fee of 0.035% (NASDAQ, 2016e). However, every individual and institutional investor should be weary of

other costs associated with equity investing which are either likely to make one's stock-broker rich only (Cox, 2006) or can even be hazardous to one's wealth (Barber and Odean, 2000). Nevertheless, by recognising the day-of-the-week effect, investors can buy/sell NASDAQ Baltic indices more effectively especially in times of information vacuum.

**Table 3. Regression estimates for each day of the week**

Regression estimates	OMXBBGI (%)	OMXT (%)	OMXR (%)	OMXV (%)
Monday	0.006 (0.879)	0.027 (0.530)	-0.072 (0.148)	-0.023 (0.546)
Tuesday	0.045 (0.370)	0.008 (0.883)	0.096 (0.147)	0.034 (0.519)
Wednesday	0.067 (0.177)	0.056 (0.319)	0.146 (0.0319)	0.084 (0.093)
Thursday	0.046 (0.356)	0.016 (0.773)	0.186 (0.009*)	0.100 (0.055)
Friday	0.072 (0.144)	0.060 (0.293)	0.210 (0.003*)	0.121 (0.014*)

Note: NB: Probability is in parentheses; \* significant at 5% level

Source: own study.

**Table 4. Adjusted regression estimates for each day of the week**

Regression estimates	OMXBBGI (%)	OMXT (%)	OMXR (%)	OMXV (%)
Monday	0.011 (0.698)	0.034 (0.325)	-0.059 (0.208)	0.007 (0.838)
Monday (min)	-4.902 (0.000*)	-5.478 (0.010*)	-10.962 (0.824)	-2.678 (0.000*)
Tuesday (max)	5.469 (0.000*)	5.554 (0.369)	7.185 (0.724)	1.833 (0.000*)
Wednesday (max)	5.807 (0.248)	5.330 (0.155)	10.653 (0.984)	1.993 (0.000*)
Tuesday	0.032 (0.445)	-0.006 (0.900)	0.076 (0.271)	-0.015 (0.736)
Wednesday	0.055 (0.224)	0.042 (0.419)	0.121 (0.079)	0.038 (0.447)
Thursday	0.041 (0.343)	0.010 (0.838)	0.173 (0.007*)	0.075 (0.104)
Friday	0.069 (0.100)	0.056 (0.248)	0.198 (0.002*)	0.097 (0.036*)
AR(1)	0.146 (0.000*)	0.136 (0.000*)	0.018 (0.000*)	0.134 (0.000*)

Note: NB: Probability is in parentheses; \* significant at 5% level

Source: own study.

## CONCLUSIONS

The very idea that investors can make money by simply exploring arbitrage opportunities that arise from daily irregularities in stock market deviations has been a subject of exten-

sive scholarly coverage. Studies varied sector and geography wise with a varying degree of evidence being presented on the subject.

Thought just surpassed its teenage years, the Baltic stock markets have been debated by industry participants and academics examining workings of the market. However, very little research was presented on the subject of calendar anomalies. This research study was therefore set to tests daily variations in the performance of the NASDAQ Baltic series.

The study examined so called day-of-the-week effect. A well-established parametric algorithm was employed to test whether returns variations are statistically different throughout week. Dummy-variable regression with an additional set of dummies that controlled for outliers in the series was performed.

An initial visual analysis presented with a compelling evidence for the day-of-the-week effect in all four series. The largest differentials were estimated for Vilnius and Riga series. Changes in an aggregate Baltic index as well as Tallinn series were less extreme.

Regression estimates however presented somewhat different results. The study found little evidence of a day-of-the-week effect in NASDAQ Baltic series. Whether it was simple regression or the one with extended parameters, numbers found no compelling evidence of the traditional underperformance on Mondays. On the other hand, and what investors could benefit from, is that Thursday and Friday came out as being positive and significant in Vilnius and Riga series. Certainly, returns differentials are modest for investors to gain superior returns. However, in times of information vacuum, investors could use these findings to trade more effectively.

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Arvydas Jadevicius has an extensive expertise in market research intelligence, data collection and investment analysis. He is a past-Chair of the European Real Estate Society PhD Network (2013-2014). In 2014, Arvydas awarded a Doctorate for his work on UK commercial property forecasting accuracy and its improvement through combination forecasting. His research was awarded with the Construction Research and Innovation (CRI) prize (ARCOM, 2010) and the Best Paper Award on Real Estate Market Analysis at the American Real Estate Society Annual conference (ARES, 2014).

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