The Impact of Taxes on Intra-week Stock Return Seasonality

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Abstract. In this paper we explore the impact of trading taxes (commissions) on day-of-the-week effect in the Lithuanian Stock market. We applied the computational model for processing trading activities only on the particular days of the week. The suggested algorithm of trading shares not only reveals presence of the day-of-the-week anomaly, but allows comparing it to the influence of the trading taxes by estimating the final return of the selected shares. As the taxes of each transaction depend on the investment sum, therefore the suggested algorithm had to optimize the number of operations for ensuring the biggest gain. The research revealed significance of intra-week stock return seasonality for majority of shares (17 out of total 24). The advantages of the suggested method include its ability to better specify the shares for performing intra-week seasonality-based transactions, even though embracing of the trading commissions reduces visibility of the effect.

Keywords: stock return, day-of-the-week effect, seasonality, operation taxes, trading strategy.

1 Introduction

Together with the internationalization of economics and finance activities and increasing on-line possibilities for trading in various financial markets of the world, the investors acquire wider powers to manage the investment portfolio. The variety of trading conditions urges to look for the markets with bigger return of investment and lower risk. Most developed markets are highly integrated and similar in profitability, therefore more attentive look of the investors is now aimed to the emerging stock markets. The abilities to indicate and exploit various trading anomalies could be helpful for gaining higher returns.

One of such anomalies is the day-of-the-week effect, which presumes that significantly different returns are regularly occurring for some particular trading day of the week. Mondays and Fridays are indicated as the trading days, mostly affected by this anomaly. Indicating the days of the week with the return, significantly different from the other days, could allow us to design the algorithm of profitable strategy.

Therefore, documenting and testing of intra-week seasonality anomalies across various markets is the interesting and ultimate task both for the researchers and traders. The research literature on the day-of-the-week stock return anomaly focuses

mainly on the United States and other advanced economies [1-6] with the inadequately low attention to the emerging markets, including those of the Eastern Europe. Recently the emerging stock markets became more interesting for the researchers, as the day-of-the-week effect in the developed stock markets from 1990s was confirmed as fading [7-11].

Basher, S.A. and Sadorsky, P. in [11] have studied the day of week effect in 21 emerging stock market by using both unconditional and conditional risk analysis and applying different analysis models. They concluded that “while the day-of-the-week effect is not present in the majority of emerging stock markets studied, some emerging stock markets do exhibit strong day-of-the-week effect”.

The empirical investigation of the day-of-the-week stock return anomaly was made by Ajayi R.A. *et al* by using major market stock indices in eleven Eastern European emerging markets [12]. The research outcomes indicate negative Monday returns in six of the Eastern European markets and positive Monday returns in the remaining five. Two of the six negative Monday returns and one of the five positive Monday returns were statistically significant.

The day-of-the-week effect in the emerging Lithuanian Stock market was investigated by authors in [13], [14], by using traditional statistical analysis methods. The research lead to the conclusion that day-of-the-week effect had no significant influence to the Vilnius Stock OMX Index return, and there were only few shares (not more than 4 from 24, as confirmed by applying different analysis methods), where affected by this anomaly.

More investigation results of the day-of-the-week effect were obtained by using artificial neural networks [15]. Two standard types of neural networks were applied: MLP (Multilayer Perceptrons) and RBF (Radial Basis Function Networks). The research outcomes revealed better sensitivity of the neural networks. Monday effect was present for 11 shares, and Friday effect was present for 9 out of total list of the 24 analysed stocks.

In this article we analyse the impact of taxes on intra-week stock return seasonality. We suggested the computational model for calculating the accumulated return by making trading activities on particular days of the week. The proposed trading strategy allows to reveal presence of the day-of-the-week anomaly and to estimate the influence of trading taxes on final return of the selected shares. The experimental research of the computational method employed the financial trading data of 24 shares of the Vilnius Stock Exchange (from 2003-01-01 to 2008-01-11).

In the following sections we present the computational model, designed for implementing stock trading algorithm, define the organization of research data set and present the results of experimental research. The research conclusions address the impact the day-of-the-week effect, influence of the sales commissions, and the problem of number of trading operations for the accumulated return of investment.

2 Computational Model for Stock Trading Strategy

In this part we present the computational model for evaluating the possible accumulated return of stock trading, exploiting the day of the week effect. The model is designed for taking into account the influence of commission taxes, trading volume and

Fig. 1. Trading strategy algorithm

number of transactions, executed for application of the designed trading algorithm. Such trading strategy gives us possibility to define the days of the week, which could be confirmed as significantly different, than the other days of the week, according to the estimated accumulated return (either higher or lower).

For implementing this strategy, the trading operations were executed only on particular days of the week and the accumulated return was estimated with and without trading commissions. Most research works neglect the impact of taxes, charged for the trading operations, or do not check the influence of this condition to intra-week

seasonality. As each operation bears the taxes of quite big value comparing to the stock price fluctuations, the trading frequency is very important parameter as well, which can lower the return considerably. In order to imitate real trading situation, the 0.3 % commissions rate was applied for the experimental data, described in the section 3. This rate is quite big and requires applying conservative trading strategy to the sufficient extent so that the total return was not totally dissolved by the trading taxes.

The stock trading strategy, implemented in the suggested algorithm is aimed to reveal presence the day-of-the-week effect, and to check if it was financial worth to take into account the day of the week of the transaction, and the frequency of trading operations. At the same time, our task was not formulated as the goal to create optimal investment strategy with the maximal return on investment, but to indicate exceptional trading outcomes by making transactions on particular days of the week.

According to the algorithm, we calculate the accumulated sum of return for selected stocks for each day of the week. We make the buying transaction only when the market is rising and the selling transaction on the day of the falling prices. In each case the trading transaction is made for all available sum of money. The accumulated return in each case is calculated in two ways: including and not including taxes. Therefore the positive return of any trading day cannot be illustrated by trade operations made on the opening and close moments of that day, as the trading taxes could exceed the generated profit. For experimental research of the trading algorithm we selected the initial investment sum 100 LTL. In this case the final earned sum of return denoted the percent rate of return. The trading algorithm is presented in Fig. 1.

By using this strategy we have possibility to research influence of number of trading operations for the final accumulated return, as this has the total impact of taxes as well. The day-of-the-week based strategy gives us the possibility to identify exclusive values of return.

3 Experimental Data and Research Results

The performance of the algorithm was analysed by processing of the financial data of the Vilnius Stock Exchange. Vilnius Stock Exchange belongs to the category of small emerging securities markets characterized by comparatively low volume, low liquidity and high volatility. It can be described by the following characteristics: market value is 7 EUR billions, near 2 million EUR of share trading value per business day, approximately 600 trading transactions per business day, and 45 shares in the equity list [16].

The experimental data set was created of the financial data of 24 most actively traded shares listed at the Vilnius Stock Exchange during the time interval from 2003-01-01 to 2008-01-11 on daily basis. The trading data was assigned to the variables, named according to their acronyms in the Vilnius Stock Exchange [16], which are further used for presenting research results in this article.

The selected set of stock data represents all variety of the list, according to the capitalization, number of shares, daily turnover, profitability and risk. The dynamics of the stock prices during the period of analysis is well reflected by the profile of OMX Vilnius Stock Index (Fig.2), which is a capitalization weighted chain linked total-return index.

In the Table 1, the final return value of the stocks, which are significantly different ($p < 0.05$) from the values of other days of the week are marked in bold font. Therefore these values indicate the days of the week, affected by the day-of-the-week anomaly.

Table 1. Final trading return after investing 100 Lt, by days of the week (including taxes)

	1	2	3	4	5	6
	Monday	Tuesday	Wednesday	Thursday	Friday	MEAN
LEL	219	285	285	249	205	248,6
KBL	71	61	51	72	123	75,6
LNS	36	47	57	129	138	81,4
LEN	132	83	163	437	121	187,2
VBL	190	94	59	225	127	139,0
LJL	90	88	126	91	35	86,0
LLK	215	137	124	117	146	147,8
KJK	141	283	159	230	420	246,6
ZMP	156	161	131	101	112	132,2
LDJ	70	119	118	76	103	97,2
RST	159	102	120	148	181	142,0
UTR	80	70	106	68	38	72,4
NDL	240	152	181	196	110	175,8
SAN	471	93	304	416	128	282,4
KNF	107	102	60	77	76	84,4
PTR	893	322	341	406	221	436,6
PZV	219	88	105	169	152	146,6
APG	83	131	112	387	80	158,6
MNF	146	336	250	145	308	237,0
SNG	69	66	63	36	72	61,2
UKB	373	104	228	206	271	236,4
RSU	112	99	83	709	241	248,8
LFO	180	204	249	192	212	207,4
TEO	80	65	67	88	144	88,8
MEAN	188,8	137,2	147,6	207,1	156,8	167,5

The average profitability of all days of the week is close to the total average value of 167.5 (as presented in the last row of Table 1). This result supports the conclusion of the [14] stating that the mean return value of the Vilnius Stock OMX Index is not impacted by the day-of-the-week effect.

Only 7 stocks of the total analysed 24, namely MNF, KNF, SAN, ZMP, LDJ, LNS, LEL, have no significantly different days by means of profitability. Therefore the majority of stocks of the Vilnius Stock Exchange are impacted by the day-of-the-week

effect. The most exclusive trading day is Friday, as the day-of-the-week anomaly is confirmed for 6 shares, and the Monday effect is noticed for five shares. The other days were only occasionally marked as significantly different, thus Monday and Friday effects had important trading impact in the observed market, similarly to the developed markets.

On the other hand, our experiment did not confirm traditional understanding that the lowest return is on Monday, and the highest - on Fridays. The results showed that in most cases the presence of the day-of-the-week effect meant the highest values of return, and only in 5 cases the significant results denoted the lowest values of accumulated return.

For performing analysis of influence of the commissions to the final return and to the significance of the day-of-the-week anomaly we compared the results including taxes (Table 1) and without them (Table 2). In both cases the same trading strategy (Fig 1) was applied for calculations. By comparing results of Table 2 and Table 1 we have to admit obvious difference in the accumulated values of final return.

From Table 1 and 2 we can notice good match of most cases the exceptional values, which indicate presence of the intra-week stock return seasonality. In Table 2 several additional stocks are marked as affected by the day-of-the-week anomaly (ZMP, LDJ, KNF). The effect itself is more visible, as the exceptional values differ clearer from the others. Thus we can conclude that by not taking into account the trading commissions we can make false identification of shares, denoting them as affected by the day-of-the-week anomaly.

The importance of the number of trading operations to identify significant return values in Tables 1 and 2 can be suggested by the research outcome, as omitting taxes (0.3%) increased the expected accumulated return by 38.5%. The biggest difference was estimated for LJJ shares – even 118.6%. This result was impacted by the maximal value of 178 sell/buy operations, performed by applying the trading algorithm. The average number of trading operations per share was 115, which means that the investment portfolio approximately is changed every 10 days. By applying the algorithm we make on average 100 buy/sell operations with one share during the five trading years. This number of operations is comparatively low and allows expecting profitable outcome of trading stocks.

The standard deviation of the number of operations for the particular days of the week is quite low - 3.4. This means that the number of trading operations does not affect the occurrence of the day-of-the-week effect. It also points to stability of the suggested computational model, as day-of-the-week effect is the outcome of difference in return for particular days of the week, but not of the parameters of trading algorithm.

One of the research aspects was to analyse, if the shares grouped according to different trading volumes, differed in their profitability, and if the day-of-the-week effect was related to the trading volume. In Table 1 the list of shares is sorted according to their average daily trading volumes in ascending order. The difference in trading volumes of the stocks was quite evident, as the lowest daily turnover (stocks LEL and KBL) was about 15 thousand LTL (1 EUR=3.45 LTL), and the highest turnover (TEO stock) reached 700 thousand LTL.

From the Table 1 and 2 any dependence of the day-of-the week effect and the trading volume could not be confirmed. This conclusion conforms to the research results, obtained by using traditional statistical methods in [15].

Table 2. Final trading return after investing 100 Lt, by days of the week (without taxes)

	1	2	3	4	5	6
	Monday	Tuesday	Wednesday	Thursday	Friday	MEAN
LEL	315	412	408	360	298	358,6
KBL	90	77	62	87	159	95,0
LNS	54	91	90	210	209	130,8
LEN	195	112	253	644	190	278,8
VBL	266	147	100	334	186	206,6
LJL	162	157	217	163	241	188,0
LLK	289	185	178	168	207	205,4
KJK	157	343	204	242	490	287,2
ZMP	197	227	193	144	168	185,8
LDJ	99	176	177	118	156	145,2
RST	249	160	198	234	281	224,4
UTR	97	88	131	84	55	91,0
NDL	249	153	182	202	125	182,2
SAN	647	85	436	479	99	349,2
KNF	153	148	89	120	116	125,2
PTR	1151	415	445	498	287	559,2
PZV	330	137	157	246	226	219,2
APG	117	197	130	560	143	229,4
MNF	226	503	374	213	466	356,4
SNG	100	84	80	63	89	83,2
UKB	517	143	329	260	344	318,6
RSU	145	150	39	1097	290	344,2
LFO	227	251	329	241	268	263,2
TEO	125	110	105	141	226	141,4
MEAN	256,5	189,6	204,4	287,8	221,6	232,0

In the articles [13], [14] the day-of-the-week anomaly was explored by applying traditional statistical research methods for the same share trading data of the Vilnius Stock Exchange. By applying t-test, one-way ANOVA, Levene and Brown-Forsythe test of homogeneity of variances, the statistically significant difference among Monday/Friday and the other days of the week was observed only for some shares with medium trading volume.

4 Conclusions

In major scientific research works the day-of-the-week effect is revealed by applying traditional statistical research methods, and the classification power of neural network or discriminant analysis.

In this work we explore impact of this effect in the Vilnius Stock Exchange by using the computational method for realization of the trading strategy, which allows highlighting the dependency accumulated return from the week day, selected for making trading transactions (buy/sell). The suggested trading strategy allowed to reveal presence of the day-of-the-week anomaly and to evaluate the influence of trading commissions to the accumulated return of selected share.

The experimental research was performed by using financial trading data set of 24 shares of Vilnius Stock Exchange (from 2003-01-01 to 2008-01-11). The suggested algorithm was applied for calculating return, accumulated by making investment operations only on the fixed trading day of the week in the Vilnius Stock Exchange. The effect was explored with and without commissions (equal to 0.3 % from every buy/sell operation). Therefore the designed algorithm had to minimize the number of operations as well.

In case of calculation without transactions taxes, the application of the suggested method revealed significant impact of this effect for 20 out of 24 shares of the Vilnius Stock Exchange. The inclusion of the buy/sell commissions weakened the visibility of the day-of-the-week effect, and its significant presence could be confirmed only for 17 shares. Thus the research confirmed the assumption that the trading taxes must be included while exploring intra-week stock return seasonality. Otherwise the significant presence of the effect could be indicated for the shares with no impact of the effect to the final accumulated return.

The other conclusion of the research is related to the high importance of the number of buy/sell transactions for more reliable identification of the presence of the day-of-the-week effect. While applying trading algorithm to very intensive trading strategy, most part of the return is lost due to the commissions applied to the increasing sales volume. Our research showed that in the designed trading strategy the buy/sell activities were quite even distributed for all week days, and could not imply significant occurrence of exclusive stock returns.

The research of financial series of the Vilnius Stock Exchange did not confirm the common understanding that the return was marked to be lowest on Monday, and the biggest - on Fridays. Though the strongest effect was really indicated for Fridays and Mondays, but on Mondays the return value was not significantly lower. In contrast, the biggest value of return was recognized for 5 shares out of 6 (without taxes).

In research findings was also noticed the absence of significant impact of the trading volume to the occurrence of the day-of-the-week effect.

Comparing to the research [13], [14] elaborated by using traditional statistical methods, we concluded that the direct method of exploring presence of the day-of-the-week effect, as applied in this work, was considerably more efficient.

The forthcoming directions of the research should deal with exploring stability of the obtained results by analysing the financial data set, updated by new stock trading data, and by implementing modifications to the stock trading algorithm.

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