The Day-of-the-Week Effect and Trading Profits

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1. Introduction

The Tokyo stock market as well as other stock markets around the world exhibit a strong weekly seasonal regularity, known as the Day-of-the-Week or Weekend effect.

The economic importance of this effect depends on whether traders could make profits by exploring it or not. If they could not, then the Day-of the-Week effect is simply a statistical anomaly from which it can not be inferred either irrational behavior by traders or informational inefficiency in the stock market. If traders could make profits, then that is evidence that either markets are not efficient or that traders do not behave rationally or both.

In the literature on Day-of-the-Week effect that we are aware of, no direct attempt has been made to determine the possibility of a trader obtaining profits by exploring this effect on individual stocks nor to estimate the magnitude of those profits. Until now, analysis of this effect as been mainly performed on market indexes, not on individual stocks, and has been primarily statistical, not financial, in nature. The conclusion of whether the Day-of-the-Week effect existed for a certain period in a given market has depended on the values obtained for the F- or t- statistics with the usual concluding remark that "when transaction costs are taken into account, the probability that arbitrage profits are

available from weekend-oriented trading strategies seems very small".

Here we break with this tradition and take direct account of transaction costs in our analysis. In Section 2 we present our testing methodology. In Section 3, we present the results of the traditional empirical tests on 37 indexes and 1135 stocks. In Section 4 we analyze the possibilities of obtaining profits from a trading strategy exploring the Day-of-the-week effect. In Section 5 we present our conclusions.

2. Methodology

In what follows we will concentrate on the average negative return on Mondays that was empirically found for several indexes of the Tokyo Stock Exchange (TSE) (Tse (1991), DosSantos (1997))[1].

To take advantage of this, and only of this negative return, an investor has to follow the trading strategy of selling short a certain stock at the closing price of the trading day prior to Monday[2] and buying it back at the Monday closing price.

To see if this strategy would have yielded profit for any stock in the TSE we will use the following testing process:

(a) estimate the average return on Mondays for each stock;

(b) given that the proportion of transaction costs per share to the transaction price decreases with the size of the order, choose the smallest order size for each stock that allows the above trading

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1) Many articles report finding Tuesday as having the lowest average return in the TSE (see for example: Pettway and Tapley (1984), Jaffe and Westerfield (1985a) (1985b), Ikeda (1988), Kato (1991)), but use older and shorter data sets than those who found Monday as having the lowest average return. This shows that the Day-of-the-Week effect is not stable, but changes with time, and thus it would be difficult for a fixed trading rule based on it to be consistently profitable.

2) Usually a Saturday or a Friday for the period that we will examine.

strategy to break even;

(c) compare this smallest order size with the average trading volume of that stock on Mondays; if the order size is larger than the average trading volume on Mondays there is no possibility of buying the necessary stock to close the position and thus it can be safely considered that there is no possibility of profitable trading; if the smallest order size is smaller than the average trading volume then it can be admitted that the above strategy might generate profit on average; finally,

(d) check the ratio of the smallest order size to the average trading volume on Mondays, because there is the possibility that if the proportion of the smallest order size necessary to break even is large in relation to the average Monday trading volume, the order may not be executed in its totality or without significant increase in the Monday closing price; thus, the lower this ratio, the higher the probability that the order execution would be successfully accomplished with a minimum disruption in price. Without empirical knowledge of how trading volume is distributed in time within Mondays, this judgment will be necessarily somewhat arbitrary.

In what follows, Section 3 corresponds to the above step (a) and Section 4 to steps (b) and (c).

3. The Day-of-the-Week effect

3.1 Data

In the tests that follow we use daily closing prices from January 5, 1987 to October 31, 1996, a total of 2484 observations, for several indexes and stocks of the TSE.

The indexes are the Topix and capitalization-weighted indexes for large, medium and small corporations and for 33 different activity sec-

tors.

The stocks analyzed are of those corporations that were listed in the first section of the TSE from January 5, 1987 to October 31, 1996, and for whom there was trading for at least 1242 days during this period. A total of 1135 stocks satisfied these conditions.

3.2 Model

To appraise the importance of Day-of-the-Week effect for an index or an individual stock, we will use the following standard model (cf. Gibbons and Hess (1981)):

$$r_t = \sum_{i=2}^{7} \alpha_i D_i + \varepsilon_t \qquad (1)$$

where r_t is the rate of return[3] of the index or stock in period t, D_i is a dummy variable for the ith day of the week (i.e., $D_2=1$ if observation t falls on a Monday and 0 otherwise; and likewise for all values of i from 2 to 7), and ε_t is a iid normal disturbance. The estimated coefficients α_i give the average return from the closing price of the previous trading day to the closing price of that weekday. The corresponding t-statistic is used to test the null hypothesis that the coefficient's true value is zero.

3.3 Estimation Results

Table 1 presents the results of the regression of equation (1) for 37 different indexes. The most salient features are:

– all indexes exhibit negative returns for Mondays that are statistically significant at the usual levels; although the magnitude of the estimated coefficients are not negative enough for profitable trading given transaction costs (see below), as indexes are averages, the

3) Defined as $r_t=(P_t-P_{t-1})/P_{t-1}$, where P_t stands for the closing price of day t.

Table 1 Estimated Coefficients

Index	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
TOPIX	−0.002098**	0.000116	0.000350	0.001170*	0.000528	0.001966
Large Capitalization Stocks	−0.002171**	0.000154	0.000328	0.001209*	0.000511	0.001969
Medium Capitalization Stocks	−0.001817**	0.000060	0.000431	0.001092*	0.000556	0.002001
Small Capitalization Stocks	−0.001403**	−0.000331	0.000396	0.000847*	0.000723	0.001790
Fisheries, Agriculture and Forestry	−0.001875*	0.000156	0.000886	0.001078	0.000438	0.000580
Mining	−0.002868**	0.000733	0.000468	0.001771*	0.000473	0.004992*
Construction	−0.001315*	−0.000345	0.000437	0.000725	0.000498	0.002015
Food	−0.002256**	0.000231	0.000373	0.001311*	0.000054	0.003556*
Textiles	−0.002289**	0.000220	0.000655	0.001166*	0.000446	0.000437
Paper	−0.001846**	−0.000195	0.000701	0.001174	0.000603	0.002560
Chemicals	−0.002345**	−0.000056	0.000799	0.001430*	0.000390	0.001699
Pharmaceuticals	−0.002341**	0.000001	0.000870	0.001263*	−0.000150	0.001536
Oil and Coal	−0.001985**	0.000335	−0.000045	0.001812*	0.000132	0.002687
Rubber Products	−0.001871**	0.000329	0.001407	0.001050*	0.000540	0.004250*
Glass and Ceramics	−0.002076**	0.000325	0.000820	0.000785	0.000281	0.003304
Steel	−0.002012**	0.000649	0.000494	0.001232	0.001253	0.001745
Non-Ferrous Metals	−0.002439**	0.000449	0.000524	0.001306	0.000464	0.002300
Ferrous Metals	−0.001432*	−0.000529	0.000679	0.001332*	0.000878	0.003289
Machinery	−0.002078**	0.000431	0.000858	0.001302*	0.000479	0.002256
Electric Instruments	−0.001889**	0.000793	0.000170	0.001176	0.000077	0.002736
Transport Machinery	−0.001554*	0.000436	0.000784	0.001897**	−0.000222	0.002012
Precision Instruments	−0.001845**	0.000412	0.000837	0.001229	0.000111	0.002867
Other Manufactures	−0.002364**	0.000434	0.000661	0.001259*	0.000430	0.001944
Gas and Electricity	−0.002207**	0.000255	0.000135	−0.000109	0.000991	0.001889
Land Transportation	−0.002213**	0.000025	−0.000291	0.001736**	0.000836	0.002661
Sea Transportation	−0.002487**	0.000077	0.001314	0.001413	0.000990	0.000285
Air Transportation	−0.002249**	0.001289	0.000486	0.000598	0.000046	−0.000492
Storage and Transportation Related	−0.001772**	0.000487	−0.000156	0.001277*	0.000843	0.001575
Communications	−0.002295**	0.000667	−0.000253	0.000404	0.000604	0.001395
Wholesale	−0.002536**	−0.000078	0.000548	0.001450**	0.000895	0.003194
Retail	−0.001752**	0.000169	0.000284	0.001108*	0.000774	0.000951
Banks	−0.001847**	−0.000100	0.000272	0.001344*	0.000748	0.001480
Securities Firms	−0.002504**	−0.000598	−0.000248	0.001746**	0.001249	0.000247
Insurance	−0.002283**	−0.000039	0.000286	0.001330	0.000551	0.002190
Other Financial Institutions	−0.001549*	−0.000364	−0.000442	0.001410*	0.000999	0.000544
Real Estate	−0.002468**	−0.000089	0.000443	0.001082	0.000564	0.002776
Services	−0.001768**	0.000285	0.000316	0.000765	0.000667	0.001410

* Significant at 5%

** Significant at 1%

possibility remains that for some of the stocks the trading strategy defined in Section 2 is profitable.

– the Day-of-the-Week effect tends to be larger for larger corporations; this result is in contrast with Kato ((1990) and (1993)), that found that the weekly pattern tends to become larger as the size decreases; the difference in results is undoubtedly due to different sampling periods;

– besides the common pattern of negative returns on Mondays there is no other easily identifiable common pattern across the indexes; for all other days we can find both positive and negative coefficients.

Table 2 presents summary statistics of the estimated coefficients and Figures 1 to 6 present graphically the distribution of the estimated coefficients for each weekday for the 1135 stocks under consideration. It can be noticed that:

– Monday is the only day when more stocks fall than rise; it should be noticed however that not every stock has an average negative

Table 2 Summary statistics of estimated coefficients

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Mean	−0.001233	0.000259	0.000787	0.001486	0.000941	0.002225
Median	−0.001396	0.000245	0.000664	0.001449	0.000851	0.002051
Maximum	0.008116	0.009018	0.009980	0.006423	0.007635	0.036721
Minimum	−0.005329	−0.003070	−0.003855	−0.002196	−0.002744	−0.015245
Std. Deviation	0.001543	0.001123	0.001127	0.001066	0.001089	0.003423
Skewness	1.082151	0.643915	1.203850	0.305686	0.736465	1.149749
Kurtosis	6.087133	6.674140	10.91948	4.074026	5.747499	13.20586
Observations	1135	1135	1135	1135	1135	1135
of which positive	190	660	888	1061	931	865
of which negative	945	475	247	74	204	264*

* The estimated coefficient of one stock was zero.

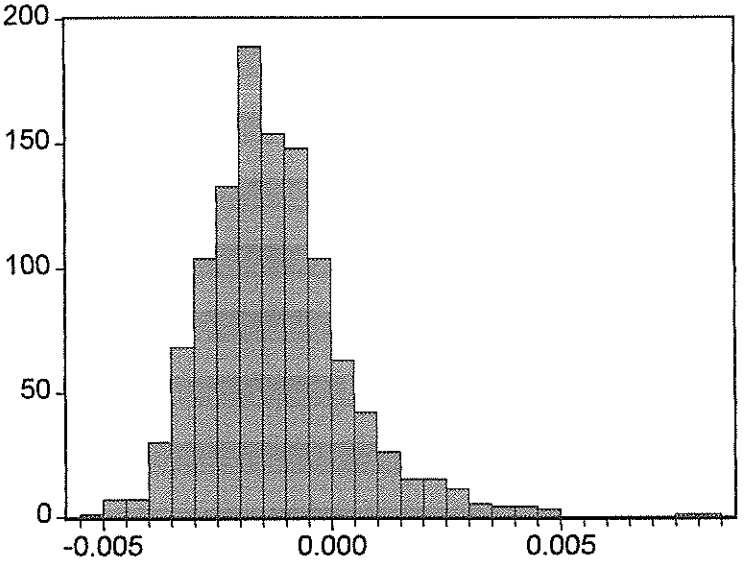

Figure 1 Estimated Coefficients for Monday

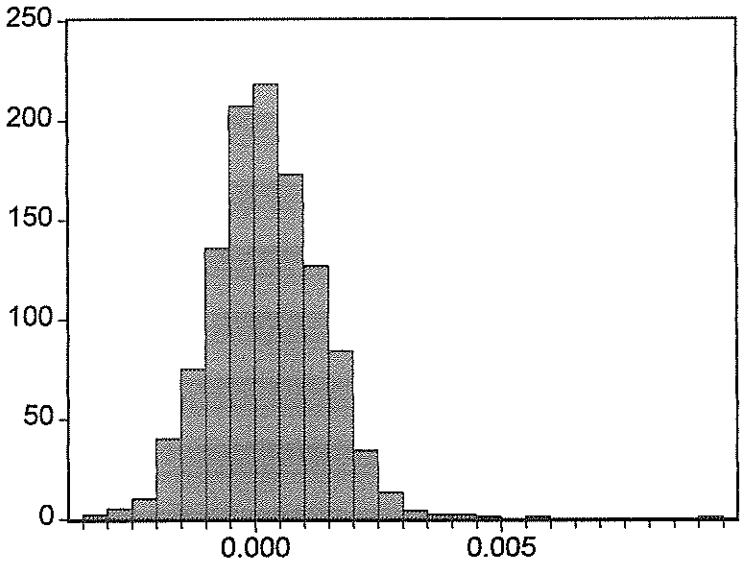

Figure 2 Estimated Coefficients for Tuesday

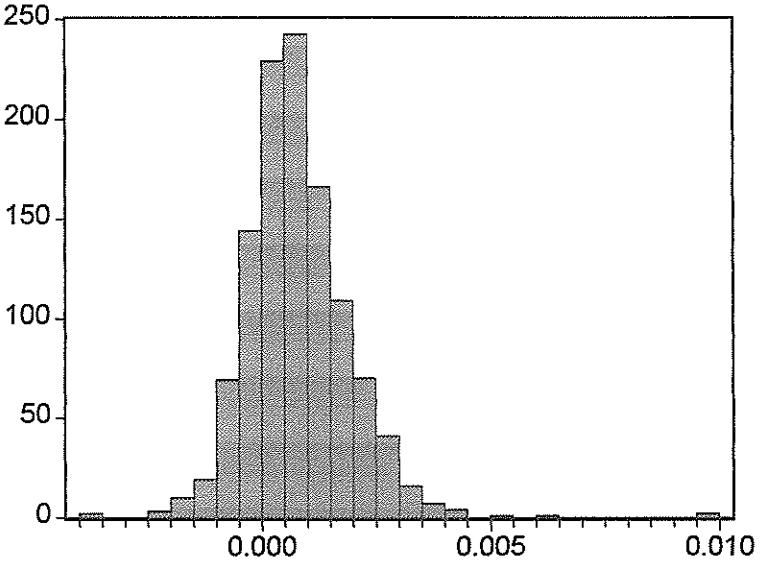

Figure 3 Estimated Coefficients for Wednesday

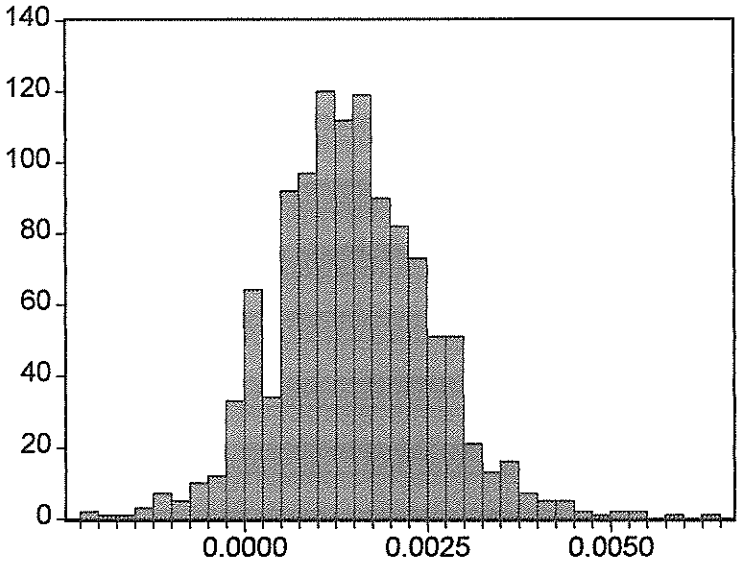

Figure 4 Estimated Coefficients for Thursday

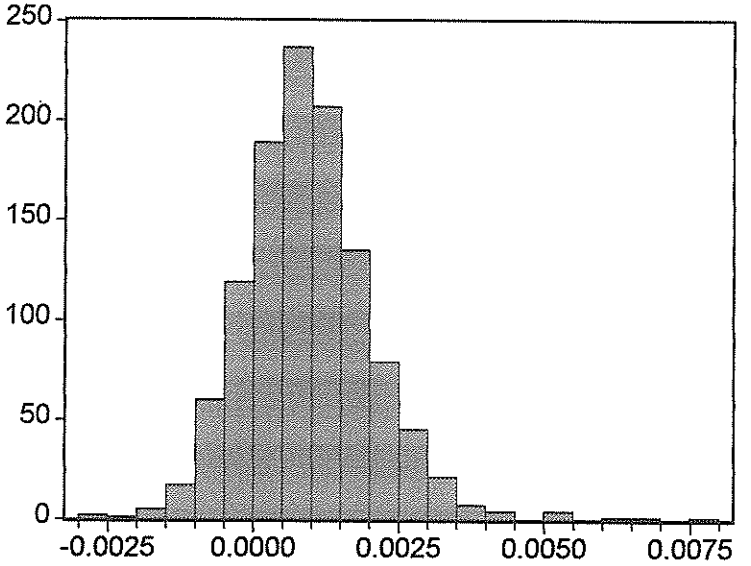

Figure 5 Estimated Coefficients for Friday

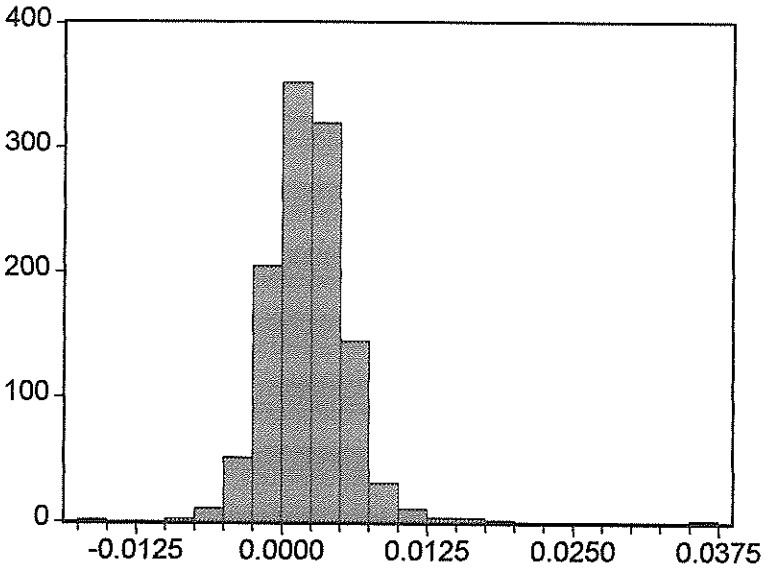

Figure 6 Estimated Coefficients for Saturday

return on Mondays or that Monday is the week day with lowest return for every stock; of the 945 negative coefficients found for Monday, only 291 (or about one quarter of the total) are different from zero at the 5% significance level and 130 (or about one tenth of the total) at the 1% level; of the 190 positive coefficients for Monday only 29 are different from zero at the 5% significance level and 10 at the 1% level; as a matter of fact, almost any conceivable weekly pattern can be observed among the 1135 stocks;

- Monday is the only day when the mean of average returns is negative;

- Monday is the only day of the week when the minimum value of average returns has enough magnitude to allow the trading strategy defined in Section 2 to be profitable;

- excluding Saturday, Monday is the day with largest dispersion of the estimated returns;

- Monday is the only week day where the absolute value of the maximum and minimum estimated values are of about the same magnitude; for all other week days the absolute value of the maximum exceeds that of the minimum by a factor of two or three.

4. Profit Possibilities

Given the above results is there any possibility of exploring the Day-of-the-Week Effect to obtain profits?

After the estimation of the average return on Mondays done above for each stock, we now have to find the smallest order size that would allow the strategy of selling short a stock at the closing price of the trading day preceding a Monday and buying it back at Monday's closing price would break even.

The total transaction costs (TC) involved by this strategy are:

$$TC = C_s(TV_{t-1}) + C_b(TV_t) \tag{2}$$

where C_s and C_b are the cost functions of respectively, selling and buying, and TV is the total value of the trade. During the period considered (1987–1996), transaction costs have not been constant as commissions and the Securities Transaction Tax have changed. To not bias our results towards finding no possible profitable trading, we will use the lowest transaction costs that existed during the period in analysis. These lower transaction costs were those at the end of the period in consideration and are summarized in Table 3.

We define, then, the selling and buying cost rates, respectively, as:

$$c_s = \frac{C_s}{TV_{t-1}} \text{ and } c_b = \frac{C_b}{TV_t}. \tag{3}$$

and the total cost rate as:

Table 3 Transaction Costs (as of October, 1996)

Commissions	
Transaction Value (TV) (thousand yen):	
less than ¥1,000	TV × 1.150%
more than ¥1,000 and less than ¥5,000	TV × 0.900% + ¥2,500
more than ¥5,000 and less than ¥1,0000	TV × 0.700% + ¥12,500
more than ¥10,000 and less than ¥30,000	TV × 0.575% + ¥25,000
more than ¥30,000 and less than ¥50,000	TV × 0.375% + ¥85,000
more than ¥50,000 and less than ¥100,000	TV × 0.225% + ¥160,000
more than ¥100,000 and less than ¥300,000	TV × 0.200% + ¥185,000
more than ¥300,000 and less than ¥500,000	TV × 0.125% + ¥410,000
more than ¥500,000 and less than ¥1,000,000	TV × 0.100% + ¥535,000
Securities Transaction Tax	
for any TV (only applicable on sales)	TV × 0.21%

Source: Nomura Securities (1996)

$$c_r = \frac{C_s + C_b(TV_{t-1}/TV_t)}{TV_{t-1}}, \tag{4}$$

Notice that as $P_{t-1} \fallingdotseq P_t$ and $TV_{t-1} \fallingdotseq TV_t$ (as seen in the previous section, they almost always differ by less than 0.5%), TV_{t-1}/TV_t will be about 1. By assuming that $TV_{t-1}/TV_t=1$ we are underestimating the real total cost rate, what fits our purpose of not biasing our results towards finding no profitable trading possibilities.

From the estimated returns for each stock we have to choose the highest c_r that makes the following Net Rate of Return (r_n) zero or slightly positive:

$$r_n = |\hat{\alpha}_2| - c_r. \tag{5}$$

$\hat{\alpha}_2$ is the estimated Monday return of each stock. From Table 3 it can be seen that for transactions amounting to ¥1,000,000,000 the selling and buying cost rates are $c_s=0.3635\%$ and $c_b=0.1535\%$ with the total cost rate of $c_r=0.5171\%$. Commissions are not fixed for transactions values of over ¥1,000,000,000 so there is the possibility that transactions which exceed this value might have lower total cost rates, but for the moment we do not consider this possibility. For the period under consideration only one stock had an estimated $|\hat{\alpha}_2|>0.5171\%$: stock 6103 Okuma. This stock had $|\hat{\alpha}_2|=0.5329\%$, resulting the short sale strategy in an average return of 0.0158%[4].

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4) To convert this value to an annual rate we can choose from several possible assumptions. For example, if it is assumed that this strategy can be used only 52 times per year (once per weekend) we get an annual rate of 0.8%; if it is assumed as in Bodie, Kane and Marcus (1993, p. 387) that it can be used during 250 trading days, then we get 4.0%; if it is assumed that it can be used continuously during the year then we get 2.5% (because this strategy would require in average about 3

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However, the ratio of an order of this size to the average trading volume on Mondays of Okuma is 7.76, precluding thus any possibility of the execution of the trading strategy under analysis.

To what extent would the results above be affected if we took in consideration the leverage effect that short selling allows? The rate of return of short sales strategies is:

$$rs_t = \frac{P_{t-1}(1-c_s) - P_t(1+c_b)}{mP_{t-1}} \tag{6}$$

where m is the minimum margin requirement. The calculations reported above assumed that $m=1$ and $P_{t-1} \fallingdotseq P_t$, restrictions that we will now lift. It should be noticed that leverage affects the rate of return only through the denominator of equation (6). Thus, as the numerator remains unchanged, for which stocks the use of the short selling strategy is profitable is not affected by the introduction of leverage.

During the 10 years under consideration the lowest allowable minimum margin requirement was changed 8 times, between a high value of 70% and a low value of 30%. To bias our results towards finding the trading strategy under consideration profitable, in the remaining calculations we will assume for the entire period the lowest allowable minimum margin requirement.

Using the rate of return of short sales (as defined in equation (6), with $m=0.3$) in equation (1) we get that the average leveraged short sales rate of return for the period in consideration of would be 0.0556%[5)]

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days from short selling to buying back, it could be repeated a maximum of 156.4 times during 365 days). For reference, the buy-and-hold strategy would have yield for Okuma for the period under analysis the annual rate of 4.2%.

5) According to the assumptions of the previous footnote we would get annualized rates of respectively 2.9%, 14.9% and 9.1%.

for Okuma. Still, the fact that this strategy could not be executed remains.

5. Conclusions

Although all indexes tested had negative returns that were statistically significant at the usual levels on Mondays, only about a quarter of the stocks tested did. Of these, only one stock had returns on Mondays that were low enough to allow the strategy of selling it short on the trading day preceding a Monday and buying it on Monday to be profitable after transaction costs were considered. However, profitable trading for this stock would require buying and selling orders so large that certainly they could not be executed.

Thus we conclude that although statistically there exists a Day-of-the-Week effect for some stocks of the TSE there is no possibility of making profit by exploring it. As it is impossible to make profits out of it, it makes no sense to present this effect as an anomaly to the Efficient Market Hypothesis or to deduct from it lack of rational behavior by stock traders.

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