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The Week Effect of the Returns and Volatilities: The Case of the Taiwanese Stock and Option Markets

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Abstract

In the past two decades, an increasing number of equity market anomalies have been reported in the literature, thus raising doubts about the applicability of the efficient market hypothesis and the capital asset pricing model. The Taiwan Stock Exchange Capitalization Weighted Stock Index Option (TXO) was introduced by the Taiwan Futures Exchange on December 24, 2001. Since the underlying asset of the TXO is the Taiwan Stock Exchange Capitalization Weighted Stock Index (TSI), the two instruments are highly correlated. The purpose of this paper is to investigate the week effects with regard to returns and volatilities for both the TXO and TSI. The results show that there is little evidence of the week effect for returns on the TXO, while it does exist for returns on the TXO. For call options, the lowest return appears on Thursday and the highest on Monday. For put options, the lowest return appears on Friday and the highest on Thursday. The evidence also shows that week effects also exist with regard to the volatilities on both the equity and option markets. The greatest volatility appears on Friday for both the TXO and TSI, and the lowest on Wednesday for the TSI.

Keywords: Week effect, option, Taiwan

Introduction

One assumption of traditional finance is that stock markets are efficient. However, over the past twenty years an increasing number of studies have highlighted anomalies that contradict this assumption, with seasonal effects, such as the January effect and week effect, having attracted much attention from both scholars and investors. These prices are thus predictable, and so can be arbitraged by the investors, meaning that the market is not efficient. The Taiwan Stock Exchange Capitalization Weighted Stock Index (TSI) is the underlying asset of the Taiwan Stock Exchange Capitalization Weighted Stock Index

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Option (TXO), and so the two instruments are expected to be highly correlated. However, few studies have explored the anomalies that exist with regard to the TXO. This work explores the efficiency of this option market by examining whether the week effect is a factor. The major contributions of this work are as follows. First, most of existing studies focus on the week effect with regard to returns, with fewer examining it in relation to volatility. Due to the high correlation between volatility and returns, this work examines whether the week effect of volatility exists in both the option and stock market in Taiwan. Next, although many studies discuss the week effect in the stock market, few focus on derivatives markets, especially on options. To date, only Dickson and Peterson (1989) and Cotner and Nayar (1993) have discussed the January effect in relation to options, with the week effect of return and volatility being ignored in this context.

Although the variables used in the current work are the same as those in Cotner and Nayar (1993), some differences do exist between both studies. First, Cotner and Nayar (1993) did not discuss the week effect of the option market. Next, the variables and the research goals of both studies are not the same. For example, Cotner and Nayar (1993) only discuss whether the January effect exists with regard to the returns of call options, and by using a dummy variable to separate the returns in January found that the returns in this month are significantly different from those in other months. In contrast, the current work further explores whether the week effect exists in the Taiwanese stock and option markets, and further discusses which days of the week have the highest returns and volatility, with the results being able to provide investors with hedging or arbitraging strategies.

Further, Cotner and Nayar (1993) only used ordinary least squares regression analysis adjusted by the correction of heterogeneous variance to analyze their data. However, Mandlebrot (1963) and Fama (1965) indicated that changes in stock prices are characterized by both high volatility and high kurtosis. This view was supported by Connolly (1989), although without taking time-varying variance into consideration. In contrast, this work uses AR (m)-GARCH (1, 1) to explore whether the week effect exists in the Taiwanese stock and option markets. The remainder of this paper proceeds as follows. Section 2 will discuss the data and variable measures. Next, Section 3 presents the empirical analysis. Finally, Section 4 gives the conclusions of this work.

Data

This work uses the daily data covering the period 2002/1/1~2003/10/31. The data are taken from the TEJ (Taiwan Economics Journal) database. This work only uses data for when the option is at the money (0.95 < (stock price-exercise price)/exercise price< 1.05). Data are excluded if the time to maturity is less than six days, or if the closing price is less than NT$ 2 (Cotner & Nayar, 1993).

Variable measures

Following the definition used in Cotner and Nayar (1993), the return is defined as follows. Further, as in Parkinson (1980), the volatility is defined as follows; where X=S (the return of stock price) or X=O (the return of option); is the highest price at day i in month t; is the lowest stock at day i in month t is the closing price at day i in month t; is the closing price at day i in month t.

Empirical analysis

Descriptive Statistics of Returns

Stock returns

In Table 1, the distribution of returns skews to the left on Monday and Thursday, while it skews to the right on Tuesday, Wednesday and Friday. Next, a high level of kurtosis exists on Monday, Wednesday and Friday, while a low level exists on Tuesday and Friday. Further, this work also examines the week effect using ANOVA and the nonparametric test, and the results show that the week effect does not exist in the Taiwanese stock market.

Option returns

The returns of call options are higher than those of put options, while both exhibit high levels of kurtosis.

The returns of call options skew to the right, while those of put options skew to the left. Therefore, in addition to the t-test, we also use the median test to examine whether the week effect exists for option returns. The empirical results indicate that the mean returns for each day of the week are not the same. We thus then use regression analysis to examine whether the week effect exists for option returns. In summary, the distribution of stock returns seems asymmetric, while that of option returns is symmetric. Based on the standard deviation, the risk of the option market is higher than that of the stock market, while the option returns are higher than stock returns. Further, the returns of call options (-0.0193) are not significantly different from those of put options (-0.0218). These results still hold when using the t-test or nonparametric test. These results still hold when using the t-test or nonparametric test.

Table 1: Descriptive statistics: returns

		n	Mean	Median	St.Dev	Skewness	Kurtosis
Call	Monday	525	0.0080	0.0165	0.3190	-0.1769	0.6707
	Tuesday	553	-0.04529**	-0.0538**	0.2784	0.4989	1.0330
	Wednesday	572	-0.0080	-0.0462**	0.3570	0.9992	5.3649
	Thursday	583	-0.043360**	-0.0216**	0.2866	-0.8424	2.4916
	Friday	606	-0.0068	-0.0082	0.3429	1.1710	11.2184
	All	2839	-0.0193**	-0.0219**	0.3192	0.5257	5.5969
Put	Monday	487	-0.0556**	-0.0719**	0.3422	0.2624	1.7846
	Tuesday	508	0.0066	0.0256*	0.2794	-0.2802	1.9887
	Wednesday	500	-0.0040	0.0069	0.3176	-0.0288	4.8568
	Thursday	542	0.0024	-0.0165	0.3170	0.4594	3.6058
	Friday	555	-0.0580**	-0.0408**	0.3373	-0.4429	4.2224
	All	2592	-0.0218**	-0.0143**	0.3206	-0.0298	3.4354
Index	Monday	93	-0.0016	-0.0015*	0.0135	-0.0149	0.2324
	Tuesday	93	-0.0028**	-0.0034*	0.0147	0.5170	-0.1412
	Wednesday	90	-0.0012	-0.0032*	0.0135	0.7383	1.1361
	Thursday	89	-0.0028*	-0.0012	0.0136	-0.3916	-0.1724
	Friday	89	-0.0007	-0.0007	0.0126	0.0170	1.0684
	All	454	-0.00186*	-0.0020**	0.0006	0.1828	0.3178

Note: * and ** denote statistical significance at the 5% and 1% levels, respectively

Regression analysis: returns

Stock returns

$$R_S\,(R_o) = \hat{\alpha}_0 + \hat{\alpha}_1 D_{1,} + \hat{\alpha}_2 D_2 + \hat{\alpha}_3 D_3 + \hat{\alpha}_4 D_4 + \hat{\alpha}_5 I_i + \hat{\alpha}_6 Moneyness_i + \hat{\alpha}_7 Maturity_i + \varepsilon_i \quad (1)$$

Where $D_i = 1, i = 1(Monday), 2(Tuesday), 3(Wednesday), 4(Thursday); 0 \quad otherwise$

I=1, after 2003/1/19, and 0, otherwise; *Moneyness*=(stock price-exercise price)/exercise price $Maturity_i$: time to maturity at day i $R_S(R_o)$ denotes the stock returns (option returns).

Table 2: Regression analysis: returns

	Model	$\hat{\alpha}_0$	$\hat{\alpha}_1$	$\hat{\alpha}_2$	$\hat{\alpha}_3$	$\hat{\alpha}_4$	$\hat{\alpha}_5$	$\hat{\alpha}_6$	$\hat{\alpha}_7$	R^2
Call option	(1)	-0.0144	0.0265*	-0.0090	0.0037	-0.0425**				0.4996
	(2)	-0.0502*					0.0446			0.4978
	(3)	-0.0129						0.9648**		0.5090
	(4)	-0.0349*							0.0004**	0.4997
	(5)	-0.0534*					0.0284	1.0501**	0.0006**	0.5127
	(6)	-0.0513*	0.0318*	-0.0097*	0.0071	-0.051**	0.0272	1.1107**	0.0007**	0.5153
Put option	(7)	-0.068**	-0.0177	0.0660**	0.078**	0.1007**				0.4363
	(8)	-0.0110					-0.022			0.4293
	(9)	-0.0161						-1.380**		0.4492
	(10)	-0.068**							0.0013**	0.4403
	(11)	-0.0372					-0.036	-1.563**	0.0015**	0.4633
	(12)	-0.081**	-0.0079	0.0614**	0.074**	0.0947**	-0.034	-1.552**	0.0015**	0.4689
Index	(13)	-0.0007	-0.0009	-0.0021	-0.0004	-0.0020				0.0162

Note: * and ** denotes statistical significance at the 5% and 1% levels, respectively

The regression analysis is shown in Table 2. The Differences between the mean of the return on Friday and those of the other days of the week are not significant different from 0. The results are consistent with the previous findings = 1.62 %, indicating that most of the ariations in stock returns can be explained by a week effect of about 1.62%.

Table 3: Descriptive statistics: volatility

		N	Mean	Median	St Dev	Skewness	Kurtosis
Call	Monday	525	0.4059**	0.3528**	0.2864	5.9142	73.5640
	Tuesday	553	0.3928**	0.3483**	0.2503	3.0833	20.8060
	Wednesday	572	0.4234**	0.3279**	0.3517	3.0142	13.2390
	Thursday	583	0.4130**	0.3450**	0.2606	2.0603	6.1980
	Friday	606	0.4191**	0.3323**	0.3248	2.6406	11.2170
	All	2839	0.41119**	0.3386**	0.2979	3.3499	23.0000
Put	Monday	487	0.4075**	0.3409**	0.2980	3.1132	17.2950
	Tuesday	508	0.3728**	0.3300**	0.2157	1.3814	3.0070
	Wednesday	500	0.3925**	0.3189**	0.2691	1.9389	5.2490
	Thursday	542	0.3933**	0.3311**	0.2410	1.8343	4.3310
	Friday	555	0.4247**	0.3241**	0.3516	3.7808	25.3090
	All	2592	0.3985**	0.3295**	0.2803	3.0478	19.8790
Index	Monday	93	0.0177**	0.0159 **	0.0077	0.8675	0.6060
	Tuesday	93	0.0186 **	0.0171**	0.0073	0.6452	0.1755
	Wednesday	90	0.0187 **	0.0162 **	0.0089	1.4609	2.8506
	Thursday	89	0.0188 **	0.0177 **	0.0066	1.0949	1.4001
	Friday	89	0.0175 **	0.0157 **	0.0077	1.2599	1.6245
	All	454	0.0183 **	0.0165**	0.0075	1.1287	1.7514

Note: * and ** denote statistical significance at the 5% and 1% levels, respectively

Option Returnsin Table 2, we can see that the return of call options on Monday is the highest, while that of put options on Thursday is the lowest. The return of put options on Thursday is the highest, while the return of put options on Friday is the lowest. The results are unchanged, even after considering opening prices of individual stock options.

The moneyness of call options is positively related with that of option returns, while the moneyness of put options is negatively related with that of option returns. The more out of the money an option is, the lower the return. The results are still unchanged, even after controlling the other factors. The time to maturity is positively related to the option returns, and thus the more time to maturity, the greater the returns. A possible reason for this is that the exercise value of an option is far from the stock price and the greater the time to maturity, the higher the level of uncertainty.

Descriptive statistics of volatility

Stock returns

Table 3 shows that the volatility of stock returns is skewed to the right and exhibits a high level of kurtosis. The results also show that the volatility for each day of the week is not the same when using ANOVA or the nonparametric test. The volatility of the stock market thus exhibits the week effect.

Option returns

The volatility of option returns is skewed to the right and has high kurtosis (i.e., variance clustering), and thus the nonparametric test is used to examine whether the means and medians are the same. The results show that the volatility of call options is higher than that of put options. In addition, the volatility of the Taiwanese option market is higher than that of stock market.

Regression analysis: volatility

3.4.1. Volatility of Stock Returns in order to control other factors which may affect the volatility of returns, we use the following regression analysis to examine whether the week effect exists with regard to volatility. The regression equation is defined as follows:

$$\sigma_{Rs}\ (\sigma_{R0}) = \beta_0 + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 + \beta_5 I_i + \beta_6 Moneyness_i + \beta_7 Maturity_i + \varepsilon_i \quad \text{... (2)}$$

Where D_i =;

=1*i=1(Monday),2(Tuesday),3(Wednesday),4(Thursday);0*

after 2003/1/19, and 0 otherwise; *Moneyness* = (stock price-exercise price)/exercise price; $Maturity_i$: time to maturity at day i ; $\sigma_S(\sigma_o)$ denotes the stock returns (option returns).

Table 4 shows the empirical results. The volatility on Friday (the coefficient is 0.0176) is significantly different from 0, indicating that the week effect exists, consistent with the previous findings (Ho & Cheung, 1994, Gordan & Tang, 1998). R^2 =0.1544, indicating that about 15.44% of variations can be explained by the explanatory variables.

Volatility of option returns

For both call and put options, the volatility on Monday is the highest and that on Wednesday is the lowest. Even after including the trading of individual stock options and other factors, the volatility of stock options decreases significantly. This may be due to the wide range of investment vehicles that are available in Taiwan, which give investors more investment choices.

With regard to call options, the moneyness is negatively related to the volatility of the option, while the moneyness of put options is positively related to the volatility of the option. After considering other factors, these relationships still exists the more out-of-the-money an option is, the greater the volatility, while the more in-the-money an option is, the lower the volatility. This may be due to lower intrinsic value of an out-of-the-money option. Summarizing the above, the Friday effect exists in both the stock and option markets. This may be due to the fact that government authorities often announce important news on Friday. However, investors cannot react to such news over the weekend, and so they react before the announcements, based on their related expectations. Similarly, because Wednesday is the middle day of the week, investors can react to news from Monday or Tuesday at this time.

Conclusions

The TXO was introduced by the Taiwan Futures Exchange on December 24, 2001. Since the underlying asset of the TXO is the TSI, the two instruments are highly correlated. The purpose of this paper is to investigate the week effects with regard to returns and volatilities for the TXO and TSI.

While there is little evidence to support the existence of the week effect for returns on the TSI while it does exist for returns on the TXO. For call options, the lowest returns occur on Thursday and the highest on Monday. For put options, the lowest returns are on Friday and the highest on Thursday.

The results also show that there are week effects for volatilities in both the equity and option markets in Taiwan. The greatest volatility appears on Friday for both the TXO and the TSI, while the lowest volatility is on Wednesday for the TXO, but on Tuesday for the TSI.

Summarizing the findings of this work, the Taiwanese option and stock markets are not efficient, in violation of traditional finance theory. In addition, during the period examined in this work, the Monday effect did not exist in either the option or stock markets, although this may be due to the study period being relatively short. After considering the GARCH effect and the error corrections, the value of R^2 obtained in this study is higher than that in Cotner and Nayar (1993).

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Table 4: Regression analysis: volatility

	Model	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	$\hat{\beta}_4$	$\hat{\beta}_5$	$\hat{\beta}_6$	$\hat{\beta}_7$	R^2
Call	(1)	0.4740**	-0.0195	-0.0354**	-0.0504**	-0.0300*				0.2233
	(2)	0.4802**					-0.1186**			0.2403
	(3)	0.3969**						-2.1880**		0.2834
	(4)	0.4870**							-0.0025**	0.2771
	(5)	0.4769**					-0.0905**	2.2851**	-0.0022**	0.2943
	(6)	0.5649**	-0.0053	-0.0371	-0.0209	-0.0108	-0.0887**	-2.4519**	-0.0032**	0.3379
Put	(7)	0.4225**	0.0025	-0.0213	-0.0340*	-0.0039				0.1950
	(8)	0.4458**					-0.0583**			0.1940
	(9)	0.3955**						1.8780**		0.2317
	(10)	0.4673**							-0.0022**	0.2539
	(11)	0.5321**					-0.0755**	-2.4943**	-0.0029**	0.3421
	(12)	0.4869**	0.0009	-0.0203	-0.0277*	-0.0009	-0.0312**	2.2097**	-0.0022**	0.2953
Index	(13)	0.0176**	0.0004	0.0008	0.0012	0.0014				0.1544

Note: * and ** denote statistical significance at the 5% and 1% levels, respectively