行政院國家科學委員會專題研究計畫成果報告

週期性異常現象之再檢視 -台灣產業別之觀察

A Further Examination of Calendar Anomalies - An Observation of Industry Groups in Taiwan

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I. 摘要

過去文獻指出產業結構在解釋股價行為上扮演重要之角色。本計畫以產業分類為基礎，檢視台灣股市於民國七十六年一月及八十六年十月間星期效應之顯著性。研究中，先以虛擬變數迴歸模型，觀察台灣各產業類股指數之日資料，是否有那些日子於一個星期當中存有潛在的異常報酬，並進而對模型中有殘值誤差項自我相關和異質變異之部分，以一般自我迴歸條件變異方式調整，再輔以大樣本數統計臨界值之考量，本研究發現部分產業的星期效應現象依然顯著。此一結果說明星期效應的存在性，可能會因產業別之不同而變化。日後異常現象之相關研究，亦當在產業分類上，多予考量。

關鍵詞詞台灣，詞期性異常現象，星期效應，產業別，市場效率性

Abstract:

Previous literature points out that industrial structure plays an important role in describing the stock price behavior. After classifying various industry groups, this study reexamines the day-of-the-week effect in Taiwan for the period between January 6, 1987 and October 2, 1997. Methodologies include ARCH/GARCH type and Bayesian-t large sample size corrections on OLS regression models. It is observed that with appropriate error term and large sample size adjustments, the potential day-of-the-week effect for the market disappeared, while abnormal positive Saturday returns remain statistically significant among some industry groups. Evidence in this study suggests that industry classification is an important factor for studying the day-of-the-week effect. The price behavior based on the aggregate market and industry groups both provide valuable information for portfolio manager's investment decisions.

Keywords: Taiwan, Calendar Anomalies, the Day-of-the-Week Effect, Industry Group, Market Efficiency

II. Background

Over the past fifteen years, numerous researchers have investigated the presence of the day-of-the-week effect. The results of these studies vary depending on the methodology employed and the market studied. Connolly (1989, 1991), for example, found that the day-of-the-week effect in the U.S. stock market disappeared when more stringent statistical tests were applied. Chang, Pinegar and Ravichandran (1993), on the other hand, found that some foreign stock markets continued to exhibit a significant day-of-the-week effect even after robustness tests were conducted. The results of the latter study, however, could be affected by the international market integration problem (Pettengill (1986)) because the authors examined stock markets in which U.S. investors are generally active participants. To minimize potential problem generated from the market integration, Lin and Walker (1996) tested the day-of-the-week effect in a local-oriented market, Taiwan. After robustness tests were applied, no evidence of a day-of-the-week effect was found in the Taiwan stock market.

Examinations on daily pattern of stock returns may ignore the potential industry effect (see Meyers 1973 and Livington 1977). Reilly and Drzycimski (1974) points out that there are substantial divergences in relative performance of stock returns among industries. Grinold, Rudd, and Stefek (1989) and Drummen and Zimmermann (1992) indicate that industry factors are important for describing the variabilities of stock returns. More recently, Roll's (1992) study shows that the industrial structure plays a significant role in explaining stock price behavior. To find out whether industry classification impact the explanation of the documented day-of-the-week effect, this study reexamines the day-of-the-week effect in Taiwan on both the market and various industry groups.

III. Data and Methodology

A. Data

In this research, I use the daily returns of the Weighted Index and eight major industry indexes provided by Taiwan Stock Exchange (TSE). Eight industries include: 1. the cement/ceramics industry (I1), 2. the food industry (I2), 3. the plastics/chemical industry (I3), 4. the textiles industry (I4), 5. the electric/machinery industry (I5), 6. the paper/pulp industry (I6), 7. the construction industry (I7) and 8. the banking/insurance industry (I8). All return information is obtained from the Taiwan Economic Journal Data Bank file for the period between January 6, 1987 and October 2, 1997. The sample consists of 3,082 observations.

B. Methodology

I first use a dummy variable ordinary least square (OLS) regression model to find out if there is a potential day-of-the-week effect in Taiwan as following:

$$R_t = \sum_{i=1}^{6} a_i D_{it} + e_t, \text{......................}(1)$$

where R_t represents the daily return for the TSE Weighted Index and various Industry Indexes on day t, D_{it} are dummy variables for different calendar dates. D_{1t} is a dummy variable that is equal to 1 if t is a Monday and zero otherwise. D_{2t} is a dummy variable for Tuesday and so on. The disturbance term is e_t.

The observed day with abnormal returns is retested by using the following OLS regression model:

$$R_t = a_0 + \sum_{i=1}^{n} a_i DAY_{it} + e_t, \text{..........}(2)$$

where n is the number of days which show significant abnormal returns in Equation (1), a_0 is the intercept, a_i is the coefficient on the dummy variable DAY_{it}. DAY_{it} equals one if the return observed on a particular day exhibits an abnormal average return.

Previous literature indicates two major concerns when conventional OLS model is applied to calendar anomalies. First, non-autocorrelation and homogeneous variance of the error terms are basic assumptions for conventional OLS model. However, when applying time series data in examining the calendar anomalies, it is highly possible that the OLS error terms are autocorrelated and the variances associated with the error terms are not consistent. Second, since large sample size are usually included in the model for examination, it should be aware that the null hypothesis will be more easily to be rejected for a given significance level. (see Lindley, 1957, Chang, Pinegar and Ravichandran, 1993 and Lin and Walker, 1996).

To render insightful views, potential autocorrelation and heteroskedasticity problems of Equation (2) are inspected by Breusch-Godfrey serial correlation LM test and White heteroskedasticity test. Any violations observed then will be further corrected by GARCH (1,1)[1] associated with either/both first-order autoregressive correction (AR(1)) or/and 'consistent standard error' heteroskedasticity adjustments. The large sample size problem will be corrected by using adjusted Bayesian-t critical value which is calculated as:

$$\text{" t - crit} = [(T - k) \cdot (T^{1/T} - 1)]^{0.5} \text{ ,...(3)}$$

where T is the number of observations, k is the number of parameters to be estimated, and $T - k$ is the number of degrees of freedom" [Chang et. al. 1993, p. 502, Lin and Walker 1996, p. 350].

IV. Results

Table 1 reports estimates of Eq. (1). Potential Saturday effect is observed for both the market and all the industries. There is a potential Friday effect for the industry of electric/machinery. The observed potential day-of-the-week effect is then rerun by Eq. (2). The coefficients, t-values and significancy of various residual tests are reported in Table 2. We may see that the Saturday effect remains significant for the market and most industries. But no conclusion should be made at current stage. As showed on Table 2, the assumptions of non-autocorrelation and homoskedasticity are violated.

After all appropriate adjustments are applied, Table 3 reports the corrected coefficients and t-values of Eq. (2). The t-values are underlined if they are greater then the Bayesian-t critical value calculated by Eq. (3). Consistent with the evidence provided by Lin and Walker (1996), this study finds that error term or/and sample size adjustments render the day-of-the-week effect in Taiwan market (on the aggregate basis) insignificant. However, the day-of-the-week effect remains robust for both the plastics/chemical industry and construction industry.

V. Conclusion

There have been numerous studies investigated the presence of the day-of-the-week effect. However, almost all of them used aggregate data for examintion and the effect of industry groups was neglected.

Industry classification should be paid

[1] The generalized autoregressive conditional heteroskedastic model. According to the survey by Bollerslev, Chou and Kroner (1992), the GARCH (1,1) model is preferred in most cases.

more attention. It is often heard that stock price rises or drops on the industry basis and portfolio managers are usually sensitive to the performance among various industry groups. A recent research (Roll, 1992) indicates that industrial structure plays a major role in explaining the stock price behavior.

In this study, I reexamine the day-of-the-week effect in Taiwan on both the aggregate market and various industry groups bases. Since a time-series/large-sample-size data set is conducted, potential violations on the assumptions of non-autocorrelation and homoskedasticity regarding the OLS error terms are inspected. After some appropriate adjusments for the observed violations regarding OLS error terms as well as the large sample size problem are applied, I find that the day-of-the-week effect remains significant in some industry groups even though the market shows no effect anymore.

The results of this study implies that the previously documented day-of-the-week effect in the States and other countries should be paid further attention on the basis of industry classification. Investment decisions inspired by the findings of previous calendar anomaly research is highly suggested to relate their concerns with various industry groups.

VI. Some Statements from the Author

Instead of using original proposed methodologies in examining three calendar anomalies, this research ends with an emphasis on the day-of-the-week effect by including more complex procedures such as the ARCH/GARCH adjustments. Personally, I feel that the results of this research are interesting. It is hoped that this report can be ready for submitting to a journal after some revising and modificaiton.

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Table 1: Coefficients and t-values for model: $R_t = \sum_{i=1}^{6} a_i D_{it} + e_t$ ....(1)

	M	I1	I2	I3	I4	I5	I6	I7	I8 $^{+,++}$
MON	.000840	.001446	.001598	.001049	.001390	.000126	-.000095	.001346	-.000334
	(0.8218)	(1.5579)	(1.6501)	(1.0917)	(1.4419)	(0.1050)	(-0.0913)	(1.2642)	(-0.2929)
TUE	-.000797	-.001079	-.000867	-.001383	-.001206	-.000456	-.001180	-.001318	.000450
	(-0.7980)	(-1.1895)	(-0.9159)	(-1.4728)	(-1.2795)	(-0.3873)	(-1.1653)	(-1.2660)	(0.4032)
WED	-.000474	-.000099	-.000053	-.000050	-.000537	.000611	-.000367	-.000223	.000824
	(-0.4741)	(-0.1092)	(-0.0559)	(-0.0527)	(-0.5691)	(0.5185)	(-0.3620)	(-0.2145)	(0.7390)
THU	.000691	-.000318	-.000666	-.000574	-.000782	-.001202	-.000680	-.001122	.000288
	(0.6909)	(-0.3503)	(-0.7026)	(-0.6109)	(-0.8286)	(-1.0201)	(-0.6701)	(-1.0765)	(0.2577)
FRI	.001297	.001000	.001011	.000720	.000919	.002857	.001705	.001476	.001597
	(1.2935)	(1.0982)	(1.0630)	(0.7639)	(0.9715)	(2.4174)*	(1.6765)	(1.4119)	(1.4258)
SAT	.002649	.001939	.002821	.003073	.002816	.003608	.002437	.003096	.002519
	(2.5804)**	(2.0784)*	(2.8973)**	(3.1834)**	(2.9055)**	(2.9810)**	(2.3406)*	(2.8926)**	(2.1968)*

* Significant at a 5% level. ** Significant at a 1% level. $^{+}$ The t-values are in parentheses. $^{++}$ M represent the market. Various industry groups are represented by: I1-cement/ceramics industry, I2-food industry, I3-plastics/chemical industry, I4-textiles industry, I5-electric/machinery industry, I6-paper/pulp industry, I7-construction industry and I8-banking/insurance industry.

Table 2: Coefficients, t-values and significancy of residual tests for model: $R_t = a_0 + \sum_{i=1}^{n} a_i DAY_{it} + e_t$.....(2)

	M	I1	I2	I3	I4	I5	I6	I7	I8 $^{+,++,\#}$
SAT	.002345	.001761	.002629	.003132	.002873	.003842	.002563	.003078	.001948
	(2.0922)*	(1.7294)	(2.4742)*	(2.9718)**	(2.7150)**	(2.8520)**	(2.2552)*	(2.6335)**	(1.5568)
FRI						.003091			
						(2.3388)*			
Corr.	NS	S	S	S	S	S	S	S	S
Heter.	NS	NS	NS	S	S	NS	S	NS	NS
ARCH	S	S	S	S	S	S	S	S	S

* Significant at a 5% level. ** Significant at a 1% level. $^{+}$ The t-values are in parentheses. $^{++}$ M represent the market. Various industry groups are represented by: I1-cement/ceramics industry, I2-food industry, I3-plastics/chemical industry, I4-textiles industry, I5-electric/machinery industry, I6-paper/pulp industry, I7-construction industry and I8-banking/insurance industry. $^{\#}$Equation (2) is first inspected by Breusch-Godfrey serial correlation LM test (represented by Corr.) Homoskedasticity assumption is checked by White heteroskedasticity test (represented by Heter.) ARCH represents the ARCH LM procedure test for autoregressive conditional heteroskedasticity (see Engle 1982). NS and S represents 'not significant' and 'significant' at a 5% level.

Table 3: Coefficients and t-values of Eq. (2) after all appropriate adjustments are applied

	M	I1	I2	I3	I4	I5	I6	I7	I8 $^{+,++,\#}$
SAT	.002300	.000297	.001582	.002115	.001975	.000889	.001205	.003199	.001767
	(1.7028)	(0.4354)	(1.8538)	<u>(2.8625)</u>**	(2.6438)**	(0.9311)	(1.5047)	<u>(3.6234)</u>**	(1.9149)
FRI						-.001201			
						(-1.6317)			

** Significant at a 1% level. + The t-values are in parentheses. They are underlined if they are significant under a Bayesian approach. By using Equation (3) described in the text, the Bayesian-t critical value here is about 2.84. ++ M represents the market. Various industry groups are represented by: I1-cement/ceramics industry, I2-food industry, I3-plastics/chemical industry, I4-textiles industry, I5-electric/machinery industry, I6-paper/pulp industry, I7-construction industry and I8-banking/insurance industry. # The coefficients and t-values reported here have been corrected by GARCH(1,1) associated with either/and AR(1) or/and 'consistent standard error' heteroskedasticity adjustments.