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反應在摩頓選擇權訂價模式之預期股利宣告效果

徐守德
國立中山大學

摘要

理論上已證明公司股利宣告會改變公司的風險。本文旨在利用隱含在選擇權訂價模式中的標準差，探索公司之風險是否在股利宣告前後發生變化。實證結果發現有利股利宣告群與不利股利宣告群之公司風險，的確在股利宣告前後發生變化。

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Anticipated Dividend Announcements Reflected in Merton's Option Pricing Model

Sode David Shyu
National Sun Yat-Sen University

Abstract

A theory has proved that a firm's risk changes around dividend announcement dates. This paper attempts to empirically examine a firm's risk by looking at the implied standard deviation derived from call option prices on dates surrounding the dividend announcement for a "clean" sample of dividend announcements. The result shows that a firm's risk does change for favorable information group and unfavorable information group.

1. Introduction

Theil [1967] defines information as a change in expectations about the outcome of an event. Within the context of this study, a firm's dividend payment is often followed by a change in the market price. Miller and Modigliani [1961] interpret such a phenomenon as a reflection of the information content of dividends. An announcement of an increase in the dividend payment usually reflects management's belief that the firm's cash flows in the foreseeable future will be sufficiently "high" and "certain" to maintain payment at the increased level. Whether or not *dividend announcements have information* is still a puzzling issue. Pettit [1972, 1976], Laub [1976], Charest [1978], Aharony and Swary [1980], Asquith and Mullins [1983], Dielman and Oppenheimer [1984], Baker, Farrelly and Edelman [1985], and Ofer and Siegel [1987] support the position that there is information in dividend announcements, while Watts [1973, 1976a, 1976b], Ang [1975], and Gonedes [1978] find no evidence of information dividend announcements. Bhattacharya [1979], Talmor [1981], and Eades [1982] have developed dividend signaling models under the assumption of asymmetric information between corporate managers and outside investors. In particular, these studies show that optimal dividends are positively correlated with the firm's average value and negatively correlated with the risk of the firm. This study will examine the actual risk profiles to determine whether dividends convey information content. An often used measure of risk for individual security is standard deviation. Given that the theory predicts changes in a firm's risk around dividend announcements dates, the main objective is to empirically examine the firm risk by looking at the implied standard deviation derived from call option prices on the dates surrounding the dividend announcement for a "clean" sample of dividend announcements.

The purpose of this paper is to examine risk around dividend announcement dates for the favorable information group, the no information group, and the unfavorable information group to ascertain the patterns of changes in risk. It has been shown by Shyu (1988) that the *Value line* forecast of dividends is a better proxy for market expectations. This finding will be used to find those firms with unexpected changes in dividend. The sample is then divided into the favorable information group, the no information group, and the unfavorable information group. Furthermore, the implied standard deviations, the weighted implied standard deviations, and the normalized weighted implied standard deviations derived from the Merton option pricing model will be computed for the three different information groups. Finally, the information content hypothesis reflected in normalized weighted implied standard deviations for the three different information groups will be tested.

2. The Data

In examining the dividend information hypothesis, a major problem is to isolate other (simultaneous) sources of important announcements from dividend announcements. Griffin [1976] classifies his sample of dividend announcements based on unexpected dividend changes within each unexpected earnings category. Watts [1973] uses realized earnings to estimate expected dividend changes and tests the information content hypothesis. Neither study isolates other significant announcements. In this study, a dividend announcement is eliminated from the sample whenever other important announcements from the same company were announced in *the Wall Street Journal Index* ten days around the dividend announcement date. Hence, the sample for this analysis will include all dividend announcements from January 1989 to December 1991 made by firms which meet the following criteria:

(i) coverage by *Value line* for the 1989-1991 period,

(ii) complete daily option trading data for the 1989-1991 period, and

(iii) no other important announcements at least five days before and five days after a dividend announcement date. Examples of important announcements include earnings reports, mergers or divestures, stock dividends and announcements of major new bond and stock issues.

3. The Dividend Information Variable

Since it has been shown that the dividend forecast made by *Value line* immediately prior to a company's dividend announcement is a better proxy for market expectations, this analysis will use it to measure market expectations. *Value line* forecasts annual dividends, and firms announce dividends quarterly, the *Value line* implied quarterly forecast can be computed from the annual forecast. The *Value line* implied quarterly forecast can be expressed as follows:

$$\widehat{D}_{ij} = \frac{\text{annual dividend}}{4},$$

where $\widehat{D}_{ij}$ is the Value line implied quarterly forecast for firm i in quarter j. $\widehat{D}_{ij}$ might experience seasonal changes if a firm adopts constant payout ratio policy. Fortunately, most firms in the sample adopt stable dividend policy. Therefore, $\widehat{D}_{ij}$ is a proper proxy for market expectations. To find those firms with unexpected changes in dividends, this study calculates the deviation of the actual dividends for firm i in quarter j ($\widehat{D}_{ij}$) from the *Value line* implied quarterly forecast $\widehat{D}_{ij}$ as follows:

$$\text{percentage change in } D = (D_{ij} - \widehat{D}_{ij})/\widehat{D}_{ij} .$$

The above equation is computed from each of the 2690 dividend announcements in which both criteria are satisfied: (1) coverage by *Value line* for the 1989-1991 period, and (2) contain of no other important announcement at least five days before and five days after a dividend announcement date. The distribution of percentage changes between the actual dividend payment and *Value line's* forecast is presented in Table 1.

Table 1 indicates that 77% [(418+1032+620)/2690]=77%] of *Value* *line's* forecasts deviates from the actual dividend by less than 10% and 37% of *Value line's* forecast is overforecast (960/2690=37%) during the 1989-1991 period. The data indicate that *Value line* had a tendency to overestimate actual dividend. Therefore, this analysis might shed light on the implications of negative announcements.

The evaluation of the information content hypothesis requires one to classify all dividend announcements into three groups favorable information, unfavorable information, and no information. As found in the Pettit [1972] and Kwan [1981] studies, there is apt to be a lot of noise in small differences between actual and forecasted dividends. In addition, Divecha and Morse [1983] show that the market reaction to dividend increases of less than 10% is not statistically significant. Therefore, the favorable information group includes those firms whose actual dividend is greater than the forecasted dividend by at least 10%; the unfavorable information group includes those firms whose actual dividend is less than the forecasted dividend by at least 10%; the rest of firms are classified into the no information group. There are 280 announcements conveying favorable information, 340 announcements conveying unfavorable information, and 2070 announcements conveying no information.

This analysis uses option data to examine the information content hypothesis. Some firms don't have any option traded in option markets or have missing value in their option prices. Hence, those firms and dividend announcements that do not have complete option trading data were deleted from the sample. The distribution of percentage changes between actual dividend payment and *Value line* forecasts from January 1989 to December 1991 is shown in Table 2 for firms which meet the previous three criteria. To test whether the distributions of Table 1 and Table 2 are similar or not, a goodness-of-fit statistic is computed and $X^2=7.19<X^2_{0.005,9}=16.92$. This study concludes that there is no significant evidence to indicate that these two distributions are different.

Table 1

Distribution of Percentage Changes between Actural Dividend Payment and Value line Forecast for the Period January, 1989-December, 1991

% Change in D			Number of Announcements
%	≧	100	10
50	≦ % <	100	22
25	≦ % <	50	47
10	≦ % <	25	201
0	< % <	10	418
0	≦ % ≦	0	1032
-10	≦ % <	0	620
-25	≦ % <	-10	251
-50	≦ % <	-25	60
-100	≦ % <	-50	29
Total			2690

Table 2

Distribution of Percentage Changes in Dividend for the Dividend Announcements Satisfied the Three Criteria for the Period January 1989 -December 1991

% Change in D			Number of Announcements
	% ≧	100	1
50	≦ % <	100	3
25	≦ % <	50	4
10	≦ % <	25	22
0	< % <	10	39
0	≦ % ≦	0	99
-10	≦ % <	0	47
-25	≦ % <	-10	33
-50	≦ % <	-25	7
-100	≦ % <	-50	2
Total			257

Table 3
Descriptive Statistics of Percentage Changes in Dividend for Different Information Groups for January 1989-December 1991

	Overall	Favorable Info. Group	No Info. Group	Unfavorable Info. Group
Number	257	30	185	42
Mean	-1.12 %	30.12 %	-0.68 %	-25.35 %
Medium	-1.22 %	24.07 %	1.48 %	-18.69 %
Standard Deviation	12.03 %	29.07 %	4.82 %	13.57 %
Maximum	100.00 %	100.00 %	9.89 %	-10.00 %
Minimum	-62.00 %	10.00 %	-9.56 %	-62.00 %

There are 257 dividend announcements which meet the three criteria during the study years. The distribution of percentage changes between the actual dividend payment and the *Value line* forecast is skewed in a negative direction. Of the 257 dividend announcements, 30 (12%) are in the favorable information group, 185(72%) are in the no information group. The descriptive statistics are provided in Table 3. The combined data have a mean of -1.12% and a standard deviation of 12.03%; the unfavorable information group has a mean of -25.35% and a standard deviation of 13.57%; the no information group has a mean of -0.68% and a standard deviation 4.82%; the favorable information group has a mean 30.12% and a standard deviation 29.07%. Table 3 indicates that the unfavorable information group has a smaller variation than that of the favorable information group. This study will utilize these 257 dividend announcements to compute their implied standard deviations using a option pricing model and then track the implied standard deviations over the days surrounding the dividend announcements.

4. Option pricing Model

Black and Scholes [1973] have derived a model for the equilibrium price of a european stock call option. According to the Black-Sholes model, the equilibrium option prices are a function of the time to maturity of the option, the exercise price, the current price of the underlying stock, the risk free rate of interest, and the instantaneous variance of the stock's rate of return. Of these five variables, only the first four can be directly observed. Hencce, instantaneous variance can be estimated by substituting the first four variables into the call option pricing model. The Black-Scholes model is given by:

$$C=SN(d_1)-Xe^{-rT}N(d_2),$$

$$d_1=[\ln(S/X)+rT]\sqrt{\delta}\ T+\sqrt{\delta}\ T/2,$$

$$d_2=d_1-\sqrt{\delta}\ T,$$

where:

C = call option price,

S = stock price,

X = exercise price of the option,

T = time to maturity of the option,

r = continuous risk-free rate of interest,

δ^2 = instantaneous variance of stock's return,

N(.) = cumulative standard normal density function.

Merton [1973] generalized the Black-Scholes model by relaxing the assumption that the stock pays no dividends. He assumes a constant known continuous dividend yield y on the stock and derives the following evaluation equations:

$$C = e^{-yt} S N(d_1) - X e^{-rT} N(d_2),$$

$$d_1 = [\ln(S/X) + (r-y)] / \sqrt{\delta}\ T + \sqrt{\delta}\ T/2,$$

$$d_2 = d_1 - \sqrt{\delta}\ T.$$

Dividend yield is computed by using quarterly dividend divided by the stock price and converted into a daily dividend yield. r is calculated by converting the current annual risk-free rate into a daily risk-free rate.

Because all dividend yeild data can be retrieved from Price-Dividend-Earnings (PDE) tape, this study employs the more pertinent Merton call option pricing model to measure implied standard deviation (ISD) for the period five days before and five days after announcement dates. The Manster-Koehler [1982] algorithm, which converges monotonically and quadratically to a unique ISD, when it exists, will be used to estimate ISD. The Manster-Koehler algorithm includes the following three steps:

Step 1: For convenience, the option pricing model can be re-written in functional form:

$$C = f(S,\ X,\ R,\ T,\ \delta,\ y). \tag{1}$$

Equation (1) has a positive solution, d*, if and only if the option is rationally priced, so that,

$$\text{Max}\ (0,\ S - Xe^{-rt}) < C < S.$$

Therefore, the first step is to check if the option is rationally priced or not.

Step 2: If an option is rationally priced, the Newton-Raphson method will be used for solving nonlinear systems of equations. The method is:

$$\delta_{N+1} = \delta_n - \frac{f(\delta_n) - C}{f'(\delta n)},$$

where δ_n is the n^{th} estimate of δ^*, and f' is the first derivative of f(d) with respect to d.

Step 3: Comparing δ_{n+1} with δ_n. If $| \delta_{n+1} - \delta_n | \leq 0.001$, then δ_{n+1} will be used to estimate the implied standard deviation, δ^*. If $| \delta_{n+1} - \delta_n | > 0.001$, then go back to step 2 to conduct the Newton-Raphson procedure to re-estimate δ^*.

As discussed by Merton [1973], there is a positive probability of early exercise when the underlying stock pays a dividend. Black [1975, p.41] suggests a method to deal with this problem:

> To figure the value of an option on a dividend-paying stock, we do two calculations of the value, and use the one that gives the higer value. The first calculation subtracts the present value of all the dividends from the stock price, and used the actual maturity date for the option. The second calculation subtracts the present value of all dividends but the last, and uses a maturity date just before the last ex-dividend date.

It is a complicated computation by adopting the above method. Hence, this research still uses Merton's model to calculate ISDs.

Because there is one hour time difference between stock trading in New York and option trading in Chicago, non-synchronous trading problem might exist in calculating ISDs.

Since stocks generally have several traded options, several different ISDs will be calculated for each stock. To obtain a single esitmate, Chiras and Manaster's [1978] weighted implied standard deviation (WISD) will be estimated. The weights are based on the price elasticity of the option which is consistent with a rational measure of return. Their formula to obtain the single WISD for each observation date is:

$$WISD_{it}=[\sum_{j=1}^{n} ISD_{ijt}(dC_{ijt}/d\delta_{ijt})(\delta_{ijt}/C_{ijt})]/[\sum_{j=1}^{n}(dC_{ijt}/d\delta_{ijt})(\delta_{ijt}/C_{ijt})],$$

where:

n = the number of options recorded on a particular stock for the observation date,

$WISD_{it}$ = the weighted implied standard deviation for the stock i on the observation date t,

ISD_{ijt} = the implied standard deviation of option j for the stock i on the observation date t,

$(dC_{ijt}/d\delta_{ijt})(\delta_{ijt}/C_{ijt})$ = the price elasticity of option j with respect to its implied standard deviation for the stock i on the observation date t.

Because each firm may have a different level of ISDs, this study will normalize the ISDs by dividing each firm's ISDs at each observation date by the firm's mean ISD. The mean ISDs is computed by taking the average of ISDs over the period. Now this study defines the Normalized Weighted Implied Standard Deviation (NWISD) for the stock i on the observation date t.

$$\text{let } ISD_{ij}=[\sum_{t=-5}^{5} ISD_{ijt}]/11,$$

$$NISD_{ijt}=ISD_{ijt}/ISD_{ij},$$

$$NWISD_{it}=[\sum_{j=1}^{n} NISD_{ijt}(dC_{ijt}/d\delta_{ijt})(\delta_{ijt}/C_{ijt})]/[\sum_{j=1}^{n}(dC_{ijt}/d\delta_{ijt})(\delta_{ijt}/C_{ijt})],$$

$t = -5$ day, -4day,...,AD,...,$+5$ day, where ISD_{ij} = mean ISD,

$NISD_{ijt}$ = normalized implied standard deviation.

5. Empirical Results

5.1. ISD

The descriptive statistics of the ISD distributions for the combined data, the favorable information group, the no information group, and the unfavorable information group are shown in Tables 4, 5, 6, and 7. Table 4 indicates that the mean ISDs decrease from day -5 to days -1 for the combined data. The standard deviations of the ISDs display no specific trend before the dividend announcement date.

Table 5 and Table 6 indicate that all the mean ISDs for the no information group are higher than those of the unfavorable information group. Tables 6 and 7 show that the favorable information group has higher mean ISDs than those of the unfavorable information group and the no information group. These results indicate that the rates of return for the no information group experience more volatility than those of the favorable information group. In addition, the rates of return for the favorable information group experience more fluctuation than those of the unfavorable information group.

Table 4

Descriptive Statistics of the ISD Derived from the Merton's Model for the Combined Data

Date	Num. of Observation	Mean	Standard Deviation	Maximum Value	Minimum Value
-5	257	0.012663	0.00367	0.0205	0.0052
-4	257	0.012652	0.00354	0.0204	0.0052
-3	257	0.012642	0.00352	0.0207	0.0052
-2	257	0.012636	0.00354	0.0209	0.0052
-1	257	0.012636	0.00356	0.0206	0.0052
0	257	0.012640	0.00364	0.0225	0.0052
1	257	0.012656	0.00363	0.0223	0.0052
2	257	0.012651	0.00363	0.0227	0.0052
3	257	0.012647	0.00362	0.0225	0.0052
4	257	0.012655	0.00360	0.0218	0.0053
5	257	0.012684	0.00364	0.0223	0.0053

Table 5

Descriptive Statistics of the ISD Derived from the Merton's Model for the Favorable Information Group

Date	Num. of Observation	Mean	Standard Deviation	Maximum Value	Minimum Value
-5	30	0.012320	0.00320	0.0205	0.0079
-4	30	0.012272	0.00314	0.0204	0.0079
-3	30	0.012266	0.00314	0.0207	0.0080
-2	30	0.012317	0.00322	0.0209	0.0079
-1	30	0.012293	0.00321	0.0206	0.0079
0	30	0.012179	0.00319	0.0211	0.0078
1	30	0.012162	0.00320	0.0210	0.0077
2	30	0.012138	0.00324	0.0211	0.0075
3	30	0.012115	0.00326	0.0211	0.0075
4	30	0.012111	0.00329	0.0213	0.0076
5	30	0.012120	0.00343	0.0222	0.0074

Table 6

Descriptive Statistics of the ISD Derived from the Merton's Model for No Information Group

Date	Num. of Observation	Mean	Standard Deviation	Maximum Value	Minimum Value
-5	185	0.013289	0.00372	0.0198	0.0063
-4	185	0.013287	0.00370	0.0198	0.0063
-3	185	0.013265	0.00367	0.0197	0.0062
-2	185	0.013244	0.00370	0.0197	0.0062
-1	185	0.013253	0.00374	0.0200	0.0062
0	185	0.013295	0.00386	0.0225	0.0062
1	185	0.013285	0.00386	0.0223	0.0062
2	185	0.013290	0.00386	0.0226	0.0063
3	185	0.013292	0.00383	0.0225	0.0063
4	185	0.013300	0.00379	0.0218	0.0063
5	185	0.013325	0.00381	0.0223	0.0063

Table 7

Descriptive Statistics of the ISD Derived from the Merton's Model for the Unfavorable Information Group

Date	Num. of Observation	Mean	Standard Deviation	Maximum Value	Minimum Value
-5	42	0.011453	0.00319	0.0175	0.0052
-4	42	0.011450	0.00316	0.0175	0.0052
-3	42	0.011466	0.00316	0.0172	0.0052
-2	42	0.011453	0.00314	0.0169	0.0052
-1	42	0.011450	0.00315	0.0175	0.0052
0	42	0.011453	0.00315	0.0173	0.0052
1	42	0.011554	0.00311	0.0173	0.0053
2	42	0.011541	0.00307	0.0169	0.0052
3	42	0.011535	0.00311	0.0171	0.0052
4	42	0.011557	0.00308	0.0173	0.0053
5	42	0.011611	0.00313	0.0178	0.0053

Table 8
The WISD Derived from the Merton's Model for Four Groups

Date	Combined Data	Favorable Information	No Information	Unfavorable Information
-5	0.012663	0.012320	0.013289	0.011453
-4	0.012652	0.012272	0.013287	0.011450
-3	0.012642	0.012266	0.013265	0.011466
-2	0.012636	0.012317	0.013244	0.011453
-1	0.012636	0.012293	0.013253	0.011450
0	0.012640	0.012179	0.013295	0.011453
1	0.012656	0.012162	0.013285	0.011554
2	0.012651	0.012138	0.013290	0.011541
3	0.012647	0.012115	0.013292	0.011536
4	0.012655	0.012111	0.913300	0.011557
5	0.012684	0.012120	0.013325	0.011609

5.2. WISD

Table 8 presents the WISD for the combined data, the favorable information group, the no information group and the unfavorable information group. For the combined data, the no information group, and the favorable information group, the WISDs display a decreasing trend from day -5 to day -2. The WISDs for the combined data display no specific patterns. The WISDs for the no information group experience a rising pattern from day -2 to day 5. For the favorable information group, the WISDs drop from day 0 to day 4. The WISDs for the unfavorable information group display a rising pattern from day 3 to day 5. The plots of these four groups from day -5 to day 5 can be seen in Figure 1.

5.3. NWISD

The descriptive statistics of NISD for the combined data, the favorable information group, the no information group, and the unfavorable information group are presented in Tables 9, 10, 11, and 12, respective-

Figure 1

The WISD Derived from the Merton's Model for the Four Groups.

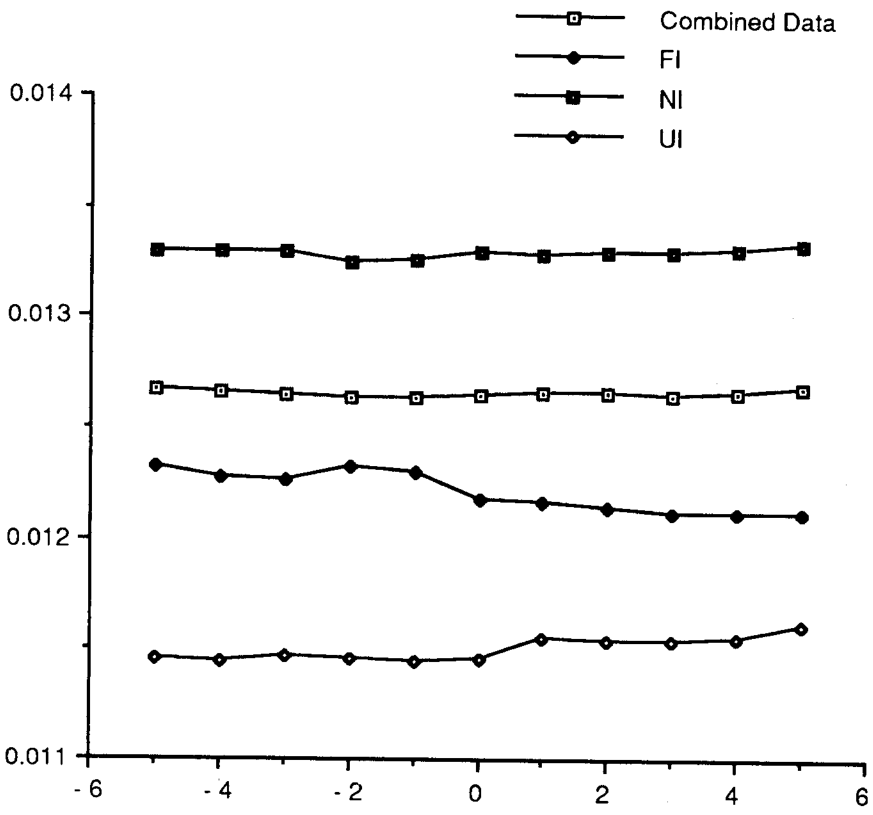


Table 9

Descriptive Statistics of the NISD Derived from the Merton's Model for the Favorable Information Group

Date	Num. of Observation	Mean	Standard Deviation	Maximum Value	Minimum Value
-5	257	1.000688	0.2746	1.0674	0.8675
-4	257	1.000260	0.02601	1.0649	0.8761
-3	257	0.999898	0.02567	1.0752	0.8538
-2	257	0.998991	0.02441	1.0709	0.8746
-1	257	0.998561	0.02360	1.0623	0.8837
0	257	0.997619	0.02173	1.0867	0.8848
1	257	0.999157	0.02099	1.1396	0.9318
2	257	0.998744	0.02144	1.1375	0.9488
3	257	0.998464	0.02337	1.1396	0.9488
4	257	0.999660	0.02337	1.1396	0.9346
5	257	1.001424	0.02663	1.1428	0.9346

Table 10

Descriptive Statistics of the NISD Derived from the Merton's Model for Favorable Group

Date	Num. of Observation	Mean	Standard Deviation	Maximum Value	Minimum Value
-5	30	1.012642	0.01836	1.0417	0.9805
-4	30	1.009783	0.02593	1.0649	0.9285
-3	30	1.009648	0.02538	1.0752	0.9324
-2	30	1.012444	0.01771	1.0598	0.9826
-1	30	1.010336	0.01725	1.0533	0.9853
0	30	1.001378	0.01965	1.0482	0.9672
1	30	0.999288	0.01503	1.0296	0.9682
2	30	0.996379	0.01850	1.0379	0.9650
3	30	0.994017	0.01866	1.0379	0.9576
4	30	0.993279	0.01880	1.0468	0.9652
5	30	0.992269	0.03001	1.0875	0.9491

Table 11

Descriptive Statistics of the NISD Derived from the Merton's Model for No Information Group

Date	Num. of Observation	Mean	Standard Deviation	Maximum Value	Minimum Value
-5	185	0.999431	0.02606	1.0674	0.8954
-4	185	0.999628	0.02434	1.0504	0.8818
-3	185	0.998256	0.02473	1.0504	0.8538
-2	185	0.996070	0.02262	1.0709	0.8746
-1	185	0.996120	0.02186	1.0545	0.8890
0	185	0.996288	0.02090	1.0867	0.9375
1	185	0.996440	0.01892	1.0756	0.9318
2	185	0.996901	0.01835	1.0756	0.9488
3	185	0.997761	0.02053	1.0864	0.9488
4	185	0.998902	0.02019	1.0543	0.9346
5	185	1.000618	0.02166	1.0756	0.9346

Table 12

Descriptive Statistics of the NISD Derived from the Merton's Model for the Unfavorable Information Group

Date	Num. of Observation	Mean	Standard Deviation	Maximum Value	Minimum Value
-5	42	0.994566	0.03385	1.0443	0.8675
-4	42	0.994519	0.02861	1.0346	0.8761
-3	42	0.996351	0.02713	1.0443	0.8848
-2	42	0.995636	0.02960	1.0350	0.8859
-1	42	0.995350	0.02909	1.0623	0.8837
0	42	0.995545	0.02530	1.0343	0.8848
1	42	1.005428	0.02778	1.1396	0.9799
2	42	1.004859	0.02869	1.1375	0.9720
3	42	1.003489	0.03141	1.1396	0.9585
4	42	1.006277	0.03134	1.1396	0.9552
5	42	1.010258	0.03229	1.1429	0.9603

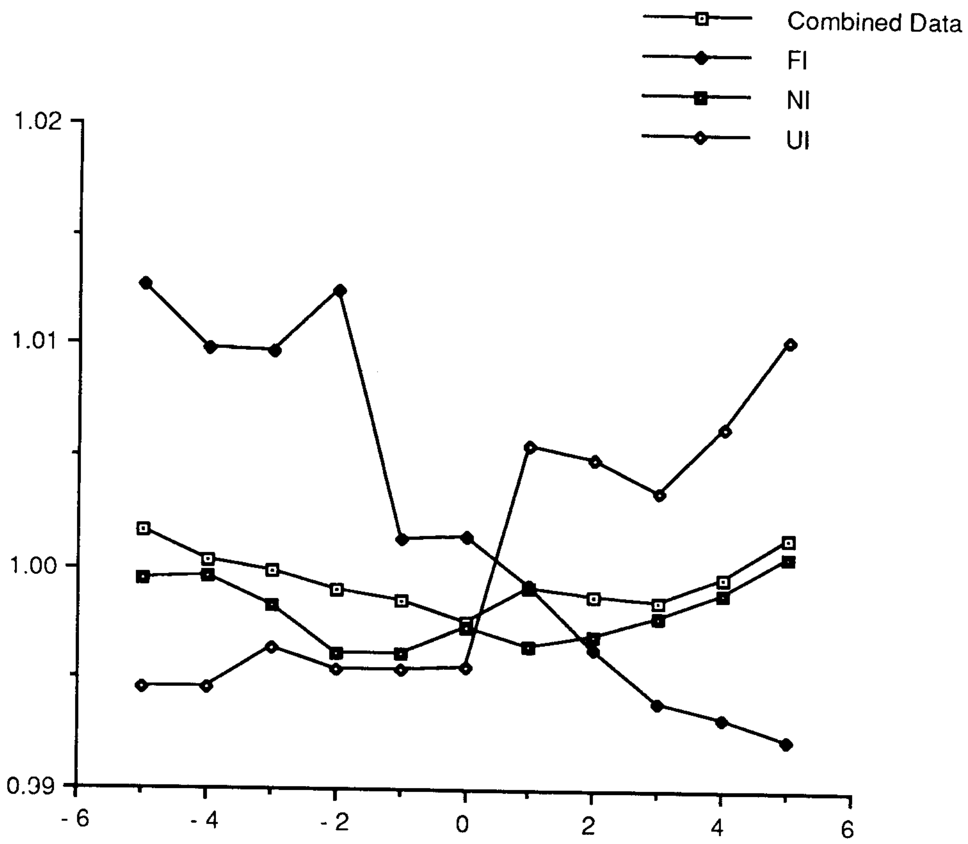
ly. The patterns of NISDs are similar to the ISDs. For example, the NISDs for the combined data decrease from day -5 to day 0, the NISDs for favorable information group display a decreasing trend from day -5 to day -3.

The final results of NWISDs for the four groups are shown in Table 13. The NWISDs for the favorable information group decrease from day 0 to day 5 and the NWISDs for the unfavorable information group displays a rising pattern from day 3 to day 5. The plots of these four groups from day -5 to day 5 can be seen in Figure 2.

Table 13
NWISD Derived from the Merton's Model for Four Groups

Date	Combined Data	Favorable Information	No Information	Unfavorable Information
-5	1.001688	1.012642	0.999431	0.994566
-4	1.000260	1.009783	0.999628	0.994519
-3	0.999898	1.009648	0.998256	0.996351
-2	0.998991	1.012444	0.996070	0.995636
-1	0.998561	1.010336	0.996120	0.995350
0	0.997619	1.001378	0.997288	0.995545
1	0.999157	0.999288	0.996430	1.005428
2	0.998744	0.996379	0.996901	1.004859
3	0.998464	0.994017	0.997761	1.003489
4	0.999660	0.993279	0.998902	1.006277
5	1.001424	0.992269	1.000618	1.010258

Figure 2
The NWISD Derived from the Merton's Model for the Four Groups



5.4. Tests of the Information Content Hypothesis

As mentioned previously, this study attempts to examine the information content hypothesis reflected in NWISD after the dividend announcement date. The hypothesized NWISD implies the following simple model and hypotheses:

$$NWISD_t = a + b_1 * t + e_t,$$
$$t = 0,1,2,3,4,5,$$

where b_1 is the slope of this model and can be intepreted as the average change in the NWISD from t-1 to t.

(al) For the favorable information group
$H_0 : b_1 \geq 0$ vs $H_A : b_1 < 0.$

(bl) For the unfavorable information group
$H_0 : b_1 \leq 0$ vs $H_A : b_1 > 0.$

(cl) For the no information group
$H_0 : b_1 = 0$ vs $H_A : b_1 \neq 0.$

This study assumes that the e_t's are mutually independent and each e_t is from the same continuous population. If these assumptions are violated, this study needs to use the runs test to examine the information hypothesis. Since this study has no knowledge of the distributions of $NWISD_t$ and the daily $NWISD_t$ seems to be mutually independent, the distributions-free Theil test [1950] will be used.

The procedure for the Theil test can be summarized as follows:

Step 1: Compute the differences
$$E_t = NWISD_t - b^* t, \quad t = 0, 1, 2, 3, \cdots, n.$$
Step 2: Let
$$C = \sum_{i<j}^{n} C(E_j - E_i),$$
where

$$c(a)=\begin{cases} 1, & \text{if } a>0 \\ 0, & \text{if } a=0 \\ -1, & \text{if } a<0. \end{cases}$$

Step 3: For the alternative hypothesis, $b<0$ at the α level of significance, the decision rule is :

$$\text{reject } H_0 \text{ if } C \geq K(\alpha, n),$$
$$\text{do not reject } H_0 \text{ if } C < K(\alpha, n),$$

where $K(\alpha, n)$ can be found from the Table A. 21 of Hollander and Wolfe [1973]. For the alternative hypothesis, $b>0$ at the α level of significance, the decision rule is :

$$\text{reject } H_0 \text{ if } C \leq -K(\alpha, n),$$
$$\text{do not reject } H_0 \text{ if } C > K(\alpha, n).$$

For the alternative hypothesis, $b \neq 0$ at the α level of significance, the decision rule is:

$$\text{reject } H_0 \text{ if } C \geq K(\alpha_2, n) \text{ or } C \leq -K(\alpha_1, n),$$
$$\text{do not reject } H_0 \text{ if } -K(\alpha_1, n) < C < K(\alpha_2, n),$$

where $\alpha = \alpha_1 + \alpha_2$.

Table 14 summarizes the results of test (a_1), test (b_1), and test (c_1). Test (a_1) is used to examine the information content hypothesis for the favorable information group. The C statistic and p-value are equal to -34 and 0.000, respectively. Hence this study rejects the null hypothesis and concludes that $b_1 < 0$ at the $\alpha = 0.05$ level of significance. The sample data do support the information content hypothesis for the favorable information groups.

The test (b_1) is used to test the information content hypothesis for the unfavorable information group. The C statistic and p-value are equal to 24 and 0.006, respectively. Therefore, we reject the null hypothesis and concluded that $b_1 > 0$ for the unfavorable information group at the $\alpha = 0.05$ level of significance. This result is consistent with the information content for the unfavorable infomration group in terms of the dispersion of the rate of return.

The test (c_1)is used to test the information content hypothesis for the no information group. The C statistic and p-value are equal to 32 and 0.000, respectively. Hence this study rejects the null hypothesis and concludes that $b_1 \neq 0$ for no information group at the $\alpha = 0.05$ level of significance. This result shows that the dividend announcement is not consistent with information content hypothesis for the no information group. Schmalensee and Trippi [1978] have found that market factor is an explanatory variable of ISD estimates. Thus, this inconsistency might be due to market-wide influences.

Next, this analysis will examine the behavior of risk before the dividend announcement date. The related model and hypotheses can be expressed as follows:

$$NWISD_t = \alpha + b_2 * t + e_t,$$
$$t = -5, -4, -3, -2, -1, 0,$$

where b_2 is the slope of this model and can be intepreted as the average change in the NWISD from t-1 to t.

(a_2) For the favorable information group
$H_0 : b_2 \geq 0$ vs $H_A : b_2 < 0$.

(b_2) For the unfavorable infomation group
$H_0 : b_2 \geq 0$ vs $H_A : b_2 < 0$.

(c_2) For the no information group
$H_0 : b_2 \geq 0$ vs $H_A : b2 < 0$.

Table 14

The Results of Test Statistics for Test (al), Test (bl), and Test(cl)

Test (al) : H_0 : $b_1 \geq 0$ vs H_A: $b_1 < 0$

i \ j	0	1	2	3	4	5
1		-1	-1	-1	-1	-1
2			-1	-1	-1	-1
3				-1	-1	-1
4					-1	-1
5						-1

$C = \sum_{i<j}^{5} C(D_j - D_i) = -34,$ p-value = 0.000

Test (bl) : H_0 : $b_1 \leq 0$ vs H_A : $b_1 > 0$

i \ j	0	1	2	3	4	5
1		-1	1	1	1	1
2			-1	-1	1	1
3				-1	1	1
4					1	1
5						1

$C = \sum_{i<j}^{5} C(D_j - D_i) = 24,$ p-value = 0.006

Test (cl) : H_0 : $b_1 \geq 0$ vs H_A : $b_1 < 0$

i \ j	0	1	2	3	4	5
1		-1	-1	1	1	1
2			1	1	1	1
3				1	1	1
4					1	1
5						1

$C = \sum_{i<j}^{5} C(D_j - D_i) = 32,$ p-value = 0.000

Table 15

The Results of Test Statistics for Test (a2), Test (b2), and Test(c2)

Test (al) : H_0 : $b_1 \geq 0$ vs H_A : $b_2 < 0$

i \ j	-5	-4	-3	-2	-1	0
-5		-1	-1	-1	-1	-1
-4			-1	1	1	-1
-3				1	1	-1
-2					-1	-1
-1						-1

$C = \sum_{i<j}^{0} C(D_j - D_i) = -24,$ p-value = 0.006

Test (b_2) : H_0 : $b_2 \geq 0$ vs H_A : $b_2 < 0$

i \ j	-5	-4	-3	-2	-1	0
-5		-1	1	1	1	1
-4			1	-1	1	1
-3				-1	-1	-1
-2					-1	-1
-1						1

$C = \sum_{i<j}^{0} C(D_j - D_i) = 14,$ p-value = 0.09

Test (c_2) : H_0 : $b_2 \geq 0$ vs H_A : $b_2 < 0$

i \ j	-5	-4	-3	-2	-1	0
-5		1	-1	-1	-1	-1
-4			-1	-1	-1	-1
-3				-1	-1	-1
-2					1	1
-1						1

$C = \sum_{i<j}^{0} C(D_j - D_i) = 18,$ p-value = 0.038

Table 15 summarizes the rsults of test(a_2), test(b_2), and test (c_2). The C statistic and p-value for test (a_2) are -24 and 0.006, respectively. Therefore, this study rejects the null hypothesis and concludes that $b_2 < 0$ for the favorable infomation group at the $\alpha = 0.05$ level of significance. This result indicates that NWISDs display a decreasing trend for the favorable information group before the dividend announcement date.

The test (b_2) is used to test the hypothesis that the risk of the rate of return for the unfavorable information group decreases before the dividend announcement date. The C statistic and p-value are equal to 14 and 0.09, respectively. Therefore, this study can be reject the null hypothesis and concludes that $b_2 \geq$ at the $\alpha = 0.05$ level of significance. This result indicates that the NWISD for the unfavorable information group do not display a trend of decreasing risk.

The test (c_2) is used to test the behavior of risk for the no infomation group before the disclosure date. The C statistic and p-value are equal to -18 and 0.038, respectively. Hence this study rejects the null hypothesis and concludes that $b_2 < 0$ for the no information group at the $\alpha = 0.05$ level of of significance.

In summary, the sample data support the hypothesis that the dividend announcement conveys information for the favorable information group and the unfavorable information group. Both the favorable information group and the no information group experience a significant decrease in NWISD before the dividend announcement date, while the unfavorable information group has no significant trend of decreasing risk at the 5% level.

6. Conclusions

On the basis of the empirical study performed, it appears that there exists some evidence to support the information content hypothesis. The result support the hypothesis that the dividend announcement conveys information for the favorable information group and the unfaable information group.

Regarding the behavior of risk before the dividend announcement date, both the favorable information group and the no information group experience a significant decrease in NWISD, while the unfavorable information group has no significant trend of decreasing risk at the 5% level.

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