Journal Of Financial And Strategic Decisions
Volume 8 Number 3 Fall 1995

EXPECTATIONS OF WEEKEND AND TURN-OF-THE-MONTH MEAN RETURN SHIFTS IMPLICIT IN INDEX CALL OPTION PRICES

Amy Dickinson* and David R. Peterson**

Abstract

This study extends the call option pricing model developed by O'Brien (1986), which has as one of the parameters the expected return on the underlying asset, to index options. Market prices of call options on the Standard and Poor's 100 stock index are used to implicitly derive the expected rate of return on the index. Two previously documented seasonal mean shifts, at the weekend and the turn-of-the-month, are examined. Empirical evidence indicates these shifts are at least partially anticipated by investors.

INTRODUCTION

Seasonal components of stock returns have been extensively documented, yet for the most part remain unexplained. Research focus into this area has primarily involved analyses of seasonal patterns by employing ex post data. While important questions have been answered, many remain.

Results of previous studies, such as by Jennings and Stark (1986), imply that the presence of an option market may improve the efficiency of the stock market. This may be accomplished by a more instantaneous and fuller reaction to available information. This logic may be extended to the inquiry of whether the expectations formulated in option prices fully incorporate information. If so, perhaps the observed seasonal patterns in stock returns are anticipated by the option market. To substantiate this hypothesis, ex ante data must be obtained. Once accomplished, various seasonal patterns can be examined.

The purpose of this study is to employ an option pricing formula to obtain the implicit expected returns of an underlying asset. The underlying asset of choice is the Standard and Poor's 100 stock index (SP100). Once the expected returns are obtained, the following question is addressed: Do expectations incorporate the recognized seasonal components of the equity market?

A number of seasonal patterns have been detected in stock return data, such as the weekend effect documented by French (1980) and Gibbons and Hess (1981). In general, these studies find the average weekend return on stocks to be negative. A turn-of-the-month effect is documented by Ariel (1987) where higher mean stock returns occur during the initial days of a trading month than during days later in the month. A turn-of-the-year effect has also been studied extensively. Keim (1983) documents a strong seasonal pattern for small firms where returns in January differ significantly from the returns earned during other months of the year. For small firms, January brings higher stock returns with much of this gain occurring in the first five trading days of the month. Large firms, on the other hand, experience negative returns during this period. Therefore, a turn-of-the-year effect appears to be a small firm phenomenon. This characterization, however, does not appear to hold for the weekend or turn-of-the-month seasonal patterns observed in stock return data.

To further document market patterns, Lakonishok and Smidt (1988) examine 90 days of daily data on the Dow Jones Industrial Average (DJIA) for the presence of seasonal components. Their findings support the persistence of seasonal

---

*Florida Atlantic University
**Florida State University
This study was partially supported by a summer research grant to David R. Peterson from Florida State University.

trends around the weekend, turn-of-the-month, and holidays. Lakonishok and Smidt do not detect a difference in January returns from other time periods, due possibly to the fact that the DJIA consists primarily of large firms.

Recent research has attempted to examine whether the options market anticipates periods of increased volatility in the stock market. Stoll and Whaley (1987) document a large increase in the volume of trading as stock index futures approach expiration. They further note that return volatility for the SP100 index significantly increases as index options and futures contracts reach expiration. Day and Lewis (1988) examine stock market volatility around option expiration, using the SP100 index. Their results indicate that option prices reflect increased volatility (using implied standard deviation estimates) around option expiration.

Building upon the recognition that stocks exhibit large returns and variability around the turn-of-the-year, Maloney and Rogalski (1989) examine the possibility that call option prices reflect these patterns. They examine implied volatility estimates in order to determine if higher return variability at the turn-of-the-year is anticipated and reflected in call option prices. Their results support this notion.

The analyses by Day and Lewis (1988) and Maloney and Rogalski (1989) are important because they examine whether seasonal variability patterns in equity return distributions are anticipated by investors. The purpose of this study is to extend this line of research by addressing whether stock market return seasonals are anticipated by investors as evidenced by expected equity returns implicit in option prices. This study employs an option pricing model developed by O'Brien (1986) to obtain the implicit expected returns of index options. These expected returns are then analyzed to determine if expectations incorporate the recognized seasonal components of the weekend and turn-of-the-month effects.

This study proceeds with an explanation of the option pricing model in Section I. The data and methodology are outlined in Section II. Empirical results are presented in Section III. Conclusions to the study follow in Section IV.

MODEL FORMATION

Since the focus of this study is to examine whether seasonal patterns exhibited in an underlying asset are anticipated by the options market, an option pricing model must be employed from which expected returns can be derived. The model employed is one developed by O'Brien (1986). O'Brien derives the following call option pricing model for a non-dividend paying stock[1]:

Equation 1

$$C = XN(d_1) - Ke^{-rt}N(d_2)$$

where:

C = current price of the call option;
X = current price of the underlying asset;
$N(\,)$ = cumulative normal density function;
d_1 = $[ln(X/K) + (\rho + ½\, \sigma_x^2)\tau] / \sigma_x\sqrt{\tau}$;
k = strike price;
ρ = expected rate of appreciation of the underlying asset;
d_2 = $d_1 - \sigma_x\sqrt{\tau}$
s_x = standard deviation of returns of the underlying asset;
τ = time to expiration.

As expressed in equation (1), the value of the call option is dependent upon the five traditional components of option pricing as well as the expected rate of appreciation of the underlying asset (ρ). In this model the underlying asset is assumed to be distributed lognormally.

If the underlying asset is a broadly based stock market index, dividend payments will be present. Since the dividends are of a small, discrete nature, however, early exercise will not be optimal.[2] If it assumed that dividends can be forecast with certainty over the life of the option, then the value of the underlying asset can be split into two components, a riskless part that is used to pay the dividends and a risky part. The risky component, the index value less the present value of the dividends, is then assumed to be lognormally distributed. Under this scenario, equation (1) becomes:

Equation 2

$$C = IN(d_1) - Ke^{-rt}N(d_2)$$

where X is replaced by I, the index value minus the present value of the dividends over the life of the option, both directly in the equation and in the definitions of d_1 and d_2. Expected returns may then be derived from this model.

DATA AND METHODOLOGY

Closing call option prices and exercise prices for the SP100, and the closing level of the SP100, are obtained from the *Wall Street Journal* (*WSJ*) on a daily basis from December 1, 1983 through January 31, 1990. The SP100 is selected for study since historically it has had, by far, the most actively traded index options. December 31, 1983 is selected as the starting date for the study since that is when trading shifted to the current format of expiration dates in the nearest three consecutive months. For each date, three option prices are selected for each of the maturities examined. For each maturity, the three exercise prices closest to being at the money are selected.[3] Option prices must be at least \$0.25 and are excluded if their price is less than the index value less the present value of the exercise price. Risk free interest rates are proxied by Treasury bill yields to maturity on bills with maturity dates as close as possible to option expiration dates, and are obtained from the *WSJ*. Annualized standard deviations of return are estimated over the previous 60 trading days using closing SP100 values.[4]

Closing option prices may not be contemporaneous with reported closing SP100 values, especially since the Chicago Board Options Exchange (CBOE) closes later than the New York Stock Exchange (NYSE). To circumvent this problem, closing SP100 values are not employed in the estimation of expected returns. Instead, the parameter is implied from the option data in a manner similar to that used by Manaster and Rendleman (1982) and Bhattacharya (1987). Thus, there are two unknowns for each day and option maturity, the expected return on the index and the implied value representing the index value less the present value of the dividends over the remaining life of the option.

For each trading day and option maturity, the implied expected return on the index, ρ^*, and the implied value of the index less the present value of the dividends, I^*, are determined as the solution to:

Equation 3

$$\underset{\rho, I}{Min\,Q} = \sum_{i=1}^{3} (C_i - C_i(\rho, I))^2$$

where C_i is the observed price of call option i and $C_i(\rho,I)$ is the model price of call option i as a function of ρ and I. Three different call options, each with a different exercise price, are employed in minimizing the sum of squared deviations.

As a further check on the quality of the data, the implied I^* is compared with the actual closing index value. If the implied value deviates from the actual value by more than one percent in absolute value, then this is interpreted as a sign of potentially bad input data, possibly arising from old option prices or from an inappropriate standard deviation input parameter due to shifts in anticipated volatility, and the solution is discarded.[5] If available, alternative options, with priority given to the proximity of the exercise price to the index value, are used to continue to search for a solution within one percent in absolute value of the actual index value. The implied expected returns are then used to address the seasonality hypotheses.

Shifts in implied expected returns are examined through a matched pairs sampling design. Since the distribution of the paired differences is unknown and the sample size is limited, the nonparametric Wilcoxon test statistic is used to compare expected returns.[6]

EMPIRICAL RESULTS

The SP100 represents a value weighted index comprised of major corporations. Although equal weighted, the DJIA is also biased toward large firms. With this similarity in mind, two major seasonal patterns documented by Lakonishok and Smidt (1988) for the DJIA, the weekend effect and the turn-of-the-month effect, are explored in this study.[7]

The Weekend Effect

The weekend effect is examined by comparing implied expected returns on Friday with implied expected returns on Monday, three calendar days later. The null hypothesis is that there is no difference in implied returns between Friday and Monday, whereas the alternative hypothesis is that expected returns increase on Monday following the negative weekend effect. Comparisons are made for the three weekends immediately preceding option expiration and are performed only for the near maturity options about to expire. Implied returns must be available on both the Friday and the Monday so a difference can be calculated. The closer to option expiration, the greater the impact of eliminating a negative weekend return on the expected return on the index over the remaining life of the option and, thus, the greater the potential for empirically detecting implied return shifts.

Empirical results of this weekend study are presented in the first three rows of Table 1. The results reported in the middle column indicate that one week prior to option expiration the annualized difference in implied returns is 5.3 percent higher at Monday's close than at Friday's close. This difference is significantly greater than zero at the five percent level. Two weeks prior to expiration the implied returns are 4.1 percent higher on Monday than on Friday, and this difference is significantly greater than zero. Three weeks prior to option expiration there is virtually no change. However, a weakening of implied return shifts is anticipated as the time to expiration grows longer.

TABLE 1
Changes In Expected Returns Implied In Option Prices From Friday Close To Monday Close

Time Period	Number Of Observations	Annualized Mean Difference In Implied Returns	Wilcoxon Test Statistic	Actual Annualized Mean Difference In Returns[a]
1 Week Prior To Expiration	62	.053*	2.98	.101
2 Weeks Prior To Expiration	61	.041*	2.56	.043
3 Weeks Prior To Expiration	54	-.008	-.89	.024
1 Week Prior To Expiration (SDA)	62	.046*	2.77	.101
2 Weeks Prior To Expiration (SDA)	61	.037*	2.68	.043

SDA=Standard Deviation Adjusted a. Obtained from Lakonishok and Smidt (1988). *Significant at the 5 percent level.

The results provided in the last column of Table 1 are intended to convey a representative figure as to the actual shift in annualized returns. The selected benchmarks are derived from figures reported by Lakonishok and Smidt (1988) in their Table 2 for the period June 1, 1952 through 1986. Using their mean daily returns, the annualized difference in returns from a holding period of Friday close through Friday close (one week) versus a holding period from Monday close through Friday close (four trading days) is 10.1 percent. Thus, the options market anticipates about half of the difference. The annualized difference in returns from a two week holding period versus a holding period from Monday close through the following Friday close (nine trading days) is 4.3 percent. Thus, the options market anticipates approximately 95 percent of the increase two weeks prior to expiration.[8]

A potential drawback of the procedure discussed above is that the standard deviation of returns is calculated over the previous 60 trading days and, thus, is relatively constant from Friday to Monday. However, there is evidence that standard deviations may not be constant. Lakonishok and Smidt (1988) and others find that weekend standard deviations are higher than daily standard deviations. Further, Stoll and Whaley (1987) find volatility increases on the last day before option expiration and Day and Lewis (1988)find similar increases in volatility measures implied in index option prices. Both the weekend and expiration effects should alter volatility measures used in the Friday versus Monday comparisons made in this study, but in conflicting directions.

To examine the sensitivity of implied return changes to volatility shifts, the following procedure is employed. First, Merton's (1973) finding that if the standard deviation is a non-constant deterministic function of time, then the standard deviation in the Black and Scholes (1973) model represents the average standard deviation over the life of the option, is assumed to hold in the present model. Second, it is assumed that standard deviations vary with the square root of time. Third, results reported by Stoll and Whaley (1987) and Lakonishok and Smidt (1988) are assumed to be representative. Stoll and Whaley (1987) find that standard deviations are approximately twice as large in the final hour of trading on the Friday which is the last trading day prior to option expiration than on other Fridays. Assuming six trading hours in a day, this represents approximately a 22.5 percent increase in the daily standard deviation of return. This number is then used to adjust the Friday standard deviation reported by Lakonishok and Smidt (1988) for the period June 1, 1952 through 1986 for the last trading day before expiration.[9] Fourth, annualized standard deviations over the remaining life of the option are computed using the daily standard deviations reported by Lakonishok and Smidt (1988), with the Friday expiration day adjusted, for the Friday close and Monday close observation points.

The above procedure yields the findings that annualized standard deviations over the life of the option decrease by approximately 1.9 percent from Friday close to Monday close one week prior to expiration, and decrease by approximately .8 percent from Friday close to Monday close two weeks prior to option expiration.[10] Implied returns are then recomputed with the Friday standard deviations left unchanged and the Monday standard deviations decreased from what they otherwise were by 1.9 percent and .8 percent one week and two weeks prior to expiration, respectively.[11] Findings from this analysis are provided in the last two rows of Table 1. Annualized differences in returns decrease, but remain statistically significant.[12] Thus, the option market appears to partially anticipate changes in index returns associated with the weekend effect.

The Turn-Of-The-Month Effect

The turn-of-the-month effect is studied by comparing implied returns three trading days prior to the turn-of-the-month with implied returns four trading days after the turn-of-the-month (a difference of six trading days). These days are selected because they represent the periods where Lakonishok and Smidt (1988) find significantly positive rates of return over some time period after 1952. Ariel (1987) also finds high rates of return during this period. The null hypothesis is that there is no difference in implied returns from prior to the month end versus after the month end, while the alternative hypothesis is that expected returns decrease after the positive returns associated with the turn-of-the-month are realized. All three option maturities are examined, with the strength of the decrease in implicit returns expected to be a negative function of the time to expiration.

Empirical results of this study are presented in the first three rows of Table 2, with the table format similar to Table 1. The results provided in the last column represent the approximate annualized return shift found by Lakonishok and Smidt (1988) for the period June 1, 1952 through 1986, and is derived from their Table 4 and the associated discussion. Implied expected return differences vary with the option maturity, and all are slightly less than the actual change in returns. The shift in expected returns for the near maturity options is statistically significant. Thus, the evidence suggests that the options market at least partially anticipates the turn-of-the-month pattern in stock returns.

The possibility exists that the turn-of-the year may be affecting the results reported in Table 2. Keim (1983) finds a strong seasonal influence, with January excess returns significantly positive for small firms and significantly negative for large firms.[13] Most important, much of the effect occurs in the first five trading days. Lakonishok and Smidt (1988), however, find that for the DJIA January returns are no different than for other months. Maloney and Rogalski (1989) find an increase in implied standard deviations around the end of the year.

The turn-of-the-year observations are removed from the sample and the test repeated, with results reported in the last three rows of Table 2.[14] The absolute magnitude of the expected return differences widens for all three maturities, and the differences for both the near and middle maturities are statistically significant. Thus, expected return patterns around the turn-of-the-year are opposite to those of the eleven remaining turn-of-the-months, possibly due to negative excess returns in early January for large firms.

There is no apriori reason to expect a shift in standard deviations over the life of the option around the turn-of-the-month, especially when the turn-of-the-year is excluded. Ariel (1987) finds no change in standard deviations of realized returns. Maloney and Rogalski (1989) find no difference in standard deviations implied in option prices around the turn-of-the-month with the turn-of-the year excluded. Thus, option prices appear to anticipate patterns in stock returns associated with the turn-of-the month.

TABLE 2
Changes In Expected Returns Implied In Option Prices From Three Trading Days Prior To The End Of The Month To Four Trading Days After The End Of The Month

Option Maturity	Number Of Observations	Annualized Mean Difference In Implied Returns	Wilcoxon Test Statistic	Actual Annualized Mean Difference In Returns[a]
Near	67	-.084*	-2.16	-.091
Middle	59	-.012	-1.45	-.030
Far	49	-.009	-.47	-.016
Near (No Turn of Year)	61	-.094*	-2.35	N.A.
Far (No Turn of Year)	43	-.016	-1.22	N.A.

a. Obtained from Lakonishok and Smidt (1988). *Significant at the 5 percent level.

CONCLUSION

This study examines whether the options market anticipates the weekend and turn-of-the-month effects in stock prices. Although there is ample documentation of these stock patterns with ex-post data, there has previously been no analysis with ex-ante data addressing whether these patterns are anticipated. Employing an option pricing model developed by O'Brien (1986) and extended to index options, implied expected rates of return on the Standard and Poor's 100 Stock Index are derived from call option prices on the index. Results indicate that both the weekend and turn-of-the-month effects are at least partially anticipated by investors.

ENDNOTES

1. The critical assumption that O'Brien (1986) makes that causes the option pricing model to differ from the traditional risk neutral valuation developed by Brennan (1979) is that of a normally distributed market factor instead of a lognormally distributed market factor. See O'Brien (1986) for a discussion of the viability of this assumption.

2. See Day and Lewis (1988) for further discussion of this issue.

3. Day and Lewis (1988) find that at the money and just in the money options are the most actively traded. For options with less than 30 days to expiration, which this study focuses on, Day and Lewis find that the just out of the money options are the third most actively.

4. This calculation ignores the impact of dividends. With relatively small, discrete payments, however, the effect should be minimal.

5. Although dividends are not incorporated as an adjustment on the closing index value, the effect should be small.

6. The parametric t-test generally yielded the same results, however.

7. The weekend effect has also been reported by French (1980), Gibbons and Hess (1981), and others. The turn-of-the-month effect has also been reported by Ariel (1987).

8. Why the options market does not fully anticipate return shifts one week prior to expiration is a topic for future research. There is a slight tendency for implied return estimates to become more volatile as expiration approaches, and this may be affecting the reported results.

9. No adjustments are made to other trading days.

10. The adjustment three weeks prior to expiration is small and did not alter the results.

11. This adjustment procedure is, of course, inexact and is merely designed to be representative. We attempted to calculate implied standard deviations as an additional parameter in the option pricing model, but estimates of implied volatilities and returns were erratic, with often sizable short term shifts that did not seem realistic.

12. The decrease in return differences is as expected. The call option price is a positive function of the standard deviation. It is a negative (positive) function of the expected return if the expected return is greater (less) than the risk free rate. Since it is typically greater than the risk free rate, if the standard deviation is artificially high on Monday and then decreased to its true value, the implied index value should increase and the implied return should decrease.

13. The SP100 more closely resembles a large firm index.

14. There is insufficient information provided by Lakonishok and Smidt (1988) to calculate the actual return shift with turn-of-the-year observations removed.

REFERENCES

[1] Ariel, Robert, "The Monthly Effect in Stock Returns," ***Journal of Financial Economics*** 18, 1987, pp. 161-174.

[2] Bhattacharya, Mihir, "Price Changes of Related Securities: The Case of Call Options and Stocks," ***Journal of Financial and Quantitative Analysis*** 22, 1987, pp. 1-15.

[3] Brennan, Michael, "The Pricing of Contingent Claims in Discrete Time Models," ***Journal of Finance*** 34, 1979, pp. 53-68.

[4] Day, Theodore and Craig Lewis, "The Behavior of the Volatility Implicit in the Prices of Stock Index Options," ***Journal of Financial Economics*** 22, 1988, pp. 103-122.

[5] French, Kenneth, "Stock Returns and the Weekend Effect," ***Journal of Financial Economics*** 8, 1980, pp. 55-70.

[6] Gibbons, Michael and Patrick Hess, "Day of the Week Effects and Asset Returns," ***Journal of Business*** 54, 1981, pp. 579-596.

[7] Jennings, Robert and Laura Starks, "Earnings Announcements, Stock Price Adjustment, and the Existence of Options Markets," ***Journal of Finance*** 41, 1986, pp. 107-125.

[8] Keim, Donald, "Size-Related Anomalies and Stock Return Seasonality: Further Empirical Evidence," ***Journal of Financial Economics*** 12, 1983, pp. 13-32.

[9] Lakonishok, Josef and Seymour Smidt, "Are Seasonal Anomalies Real? A Ninety-Year Perspective," ***Review of Financial Studies*** 1, 1988, pp. 403-425.

[10] Maloney, Steven and Richard Rogalski, "Call-Option Pricing and the Turn of the Year," ***Journal of Business*** 62, 1989, pp. 539-552.

[11] Manaster, Steven and Richard Rendleman, Jr., "Option Prices as Predictors of Equilibrium Stock Prices," ***Journal of Finance*** 37, 1982, pp. 1043-1057.

[12] O'Brien, Thomas, "A Discrete Time Option Model Dependent on Expected Return: A Note," ***Journal of Finance*** 41, 1986, pp. 515-520.

[13] Stoll, Hans and Robert Whaley, "Program Trading and Expiration-Day Effects," ***Financial Analysts Journal*** 453, 1987, pp. 16-28.