THE IMPACT OF OPTION EXPIRATION ON UNDERLYING STOCK PRICES AND THE DETERMINANTS OF THE SIZE OF THE IMPACT

by

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As members of the Final Examination Committee, we certify that we have read the dissertation prepared by Dan Wortham Hess

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and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy.

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Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copy of the dissertation to the Graduate College.

I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

Mark A. Hanson	Dec. 1, 1982
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ABSTRACT

The purpose of this study is to investigate the daily return behavior of underlying common stocks in the period surrounding the option expiration date. A second purpose is to determine the variables that may be causing the differential capital market effect across firms.

The hypothesis of a negative return effect in the expiration week followed by a positive effect in the subsequent week is tested first. It is shown that this pattern should be expected due to the enhanced opportunity for and profitability of position unwinding, arbitrage and manipulation activity as the expiration date approached. The study period covers 32 expiration periods from 1978 through 1981 and involves a sample of 138 underlying stocks. The study employs the market model for generating abnormal returns on a daily basis. The results support the hypothesis and in particular show that the most significant negative return behavior occurs on Thursday and Friday of the expiration week.

The second phase of the study correlates, via a cross-sectional multiple regression model, the suggested expiration induced events of position unwinding, arbitrage and manipulation activities with the return behavior of the underlying stocks. It is hypothesized that those common

stocks which exhibit the greatest negative returns in the expiration week are those stocks and related call options that are most heavily involved in position unwinding, arbitrage and manipulation activities.

Trading volume in both the underlying stock and the options is suggested as a surrogate for these three activities. Therefore, volume is negatively related to underlying stock returns. Two additional explanatory variables of the expiration week returns are included in the regression model. A negative relationship is hypothesized if options are dually listed and a positive relationship if puts are traded. The results of the tests generally support these hypothesized functional relationships.

The study concludes that, although significant abnormal returns and explanatory variables are found, the magnitudes are probably not large enough to profitably exploit after paying transaction and search costs. As puts trading appears to offset the market inefficiencies caused by call option trading, the concern of regulators that options trading unduly affects stock prices seems unwarranted.

CHAPTER I

INTRODUCTION

Listed stock options have been one of the fastest growing and most dynamic segments of the securities industry in recent years. This rapid growth resulted from several innovations instituted by the first options exchange, the Chicago Board Options Exchange, which greatly reduced several of the drawbacks of the "old" OTC options market. Borrowing some concepts from the commodities futures market, the CBOE standardized expiration dates and exercise prices and created a central clearing corporation. The Options Clearing Corporation allows option sellers to make closing purchases and option buyers to simply sell their options on the exchange, rather than exercise. These innovations made possible a liquid secondary market in options with continuous public reporting of prices, volume and open positions. In general, the new options market provided reduced transaction costs, increased liquidity and in time a relatively efficient market.

However, the very success of this new market raised questions as to the economic effect of options trading. The Securities and Exchange Commission, exchanges and market participants were concerned about questions such as whether

options trading might impact the raising of capital by business and in particular the new issues market for low-priced stocks which might be competing with options for the investor's dollars. For example, a study sponsored by the CBOE developed statistics on the overlapping involvement of investors in options and new issues of small companies (Robbins, 1977). The basic conclusion of the study was that the frequently expressed belief that exchange trading of options has caused a negative impact on the market for small new issues, is based on conjecture, mostly of an uninformed nature. A second question often raised dealt with the efficiency of the options market. A study of this topic by Galai (1977) generally concludes that although it is not perfectly efficient, the options market is sufficiently efficient to preclude the obtaining of abnormal returns by the public.

The Purpose of the Study

Thirdly, many questioned the impact of options trading on the market for the underlying common stocks (Chicago Board Options Exchange [CBOE], 1975, 1976; Klemkosky, 1978; Klemkosky and Maness, 1980; Kopprasch, 1977; Nathan, 1974; Securities and Exchange Commission [SEC[, 1979; Way, 1976; Anders, 1982). The purpose of this study is to investigate this third question and in particular the impact on the underlying share prices around the

expiration date of the related options. This has been an area of controversy ever since the CBOE first opened in 1973. Many NYSE specialists claim that options cause stocks to be pulled down in the final days before expiration (Lenzner, 1976), while the option exchanges say they have evidence that options have no effect on stocks during this period (CBOE, 1975, 1976). A basic premise that supports at least the possibility of the claim that options affect stocks is that since the value of an option is dependent on the underlying stock, arbitrage opportunities exist as well as motivation for stock price manipulation to generate profits in the related options. Also, the increased unwinding of option positions in the final days before expiration could potentially cause increased activity in the underlying stock where stock/option hedges are involved.

Theoretically, the option's value is dependent on, among other variables, the underlying stock price. This study will look into the possibility that the causation could be reversed so that a possible "tail wagging the dog" effect is present. Two recent studies (Klemkosky, 1978; Kopprasch, 1977) suggest that options may affect underlying securities during the week surrounding expiration. However, these studies were constrained by the use of weekly data and a short time period for analysis. Also, there was no attempt made to identify the factors that may explain why certain

stocks exhibit substantial abnormal price behavior while others are virtually unaffected.

The Scope of the Study

Using data from 1978 through 1981, this study first examines the daily returns of approximately 140 underlying stocks during the ten days surrounding the option expiration date. The null hypothesis is that no risk-adjusted abnormal returns will be present. The alternative hypothesis is that risk-adjusted negative abnormal returns will occur in the week preceding the expiration date. And further, as this will be tested using daily data, it is hypothesized that the greatest abnormal returns will be found to occur in the later part of the week, when the expiration effect on the underlying stocks reaches a peak. A second hypothesis is that market equilibrium will return in the subsequent week; therefore, the alternative hypothesis is that positive abnormal returns are expected then.

The second major section of the study is an attempt to determine those variables that may be causing the differential capital market effects across firms as posited above. During the few days preceding expiration, certain pressures come to bear on the relationship between the underlying stock and option prices. These pressures create enhanced opportunity for trading profits by market participants engaging in arbitrage, position unwinding and

manipulation. It can be shown that these three activities can create downward pressure on stock prices. Observable variables that surrogate for or increase the ability to engage in these three activities are suggested. It is hypothesized that the magnitude and sign of the abnormal returns in the week prior to the option expiration, on an individual stock basis, are negatively related to the level of stock and option volume during the expiration week. It is further hypothesized that the magnitude and sign of the abnormal stock returns are positively related to whether put options are traded on the underlying stock and negatively related to whether the options are dually listed.

The methodology used to explore the price impacts suggested above consists of a sequence of two tests. The first test, to measure the effect of the options expiration on the price of the underlying stock, is a residual analysis in which abnormal security returns are estimated around the expiration date using the "market model" to control for the differential effects of market-wide information on individual security prices. The second phase of the testing involves the construction of a cross-sectional regression model that uses the abnormal returns found in the phase one tests as the dependent variable. These abnormal returns are regressed on the observable variables suggested above. The definition and measurement of the variables are discussed in Chapter V.

Significance of the Study

This study is significant for the following reasons. It refines previous work as well as explores new areas not dealt with in previous research. It seeks to determine on a daily rather than weekly basis if and when abnormal stock performance is taking place. The use of daily data allows a more refined analysis of the relationship between stock price behavior and option expirations. It would be significant for market participants if it were found that the majority of this abnormal performance was taking place on one or two days during the two week analysis period. The weekly time period used in previous research may be too long, with the result that important expiration-induced effects are hidden and missed. Secondly, and possibly more important, this study in seeking to determine the significant factors that cause the abnormal price behavior could provide important information to market traders. If this study finds, for example, that option and/or stock trading volume is significantly correlated to abnormal performance, these observable factors could aid traders in exploiting this seeming inefficiency in the market.

Organization of the Study

The remainder of the paper is organized as follows: Chapter II reviews the literature on the topic and related methodologies. Chapter III explains the theoretical

justification for the reason why the existence of options could cause abnormal stock price behavior around the expiration date and why the explanatory variables mentioned above could cause this behavior. Chapter IV develops several hypotheses that suggest a functional relationship between the expected capital market reaction and several observable variables. Chapter V explains the methodology and tests that are run to either prove or disprove the hypotheses. Chapter VI covers the test results and Chapter VII outlines the implications of this research to market participants and regulators, as well as presents some conclusions.

CHAPTER II

LITERATURE REVIEW

The purpose of this chapter is to review the literature dealing with the question of whether options trading has had an impact on the underlying stocks. The literature discussed deals primarily with the impact around the expiration date, as this is the subject of this paper. The chapter is divided into three sections. The first section discusses the literature that claims options have no effect on the underlying stocks. The second section discusses the literature that refutes this notion of no effect, and the last section summarizes the chapter and points out the need for further research on the topic.

Evidence of No Option Expiration Impact

This section reviews three studies that purport to show no impact of options trading on the underlying stocks. It should be noted that one of these studies was commissioned by the Chicago Board Options Exchange (Nathan, 1974) and the other two were done by the CBOE's own research department. Therefore, the desired results of these studies is to show that options trading has no effect on the underlying stocks. Evidence to the contrary might have led to

restrictions on options trading. The objectivity of these studies could be questioned given the biases of the preparers.

Nathan Report

The first and perhaps the most comprehensive review of the effect of options trading is the Nathan Report (Nathan, 1974). This study, commissioned by the CBOE, looked at option impact on underlying stocks near expiration as well as a number of other questions. This study was updated by the CBOE in July 1975 and again in February 1976. The study concludes that options trading had little discernible effect on: (1) the liquidity or operational efficiency of the stock market, (2) volume of trading relative to NYSE volume, and (3) price changes or price performance relative to the NYSE market as a whole. The Nathan Study also concluded that: (1) exercise of options during expiration week had no systematic effect on the daily price behavior of the underlying stock, (2) no regular or consistent pattern could be found between the daily open interest for expiring options exercisable below or at the current stock price and the price movements of the underlying stocks, (3) the average closing bid/ask spreads of options stocks was somewhat narrower than the spreads of a sample of other stocks, and (4) the volatility of the price

of the underlying stocks on which options were traded was less after options trading began.

This review will not describe in more detail the tests and resulting conclusions of the Nathan Report that pertain in particular to this study. One test performed in the Nathan study attempted to determine the possible impacts of changes in open interest on the prices of the underlying stocks. This test attempts to relate long term (approximately two months) changes in open interest to price changes over that period of time. The basic methodology was to choose three separate time periods of approximately 2-1/2 months. The option classes which were traded for the entire interval were those tested in each period. The time periods chosen, performance of the NYSE composite index, and the number of stocks included in each are given below:

May 31 to August 16 1974	-1.54%	16 stocks
August 16 to October 25	+8.93%	27 stocks
October 25 to December 28	-12.93%	32 stocks

The price of each stock at the end of the period was related to its price at the beginning of the period, and this ratio was related to a similarly constructed ratio for the NYSE composite index. Change in open interest (the independent variable) was expressed relative to corresponding NYSE volume in the stock and to shares outstanding. Regression analysis was used to determine the relationship

(if any) of stock price to change in open interest. The regression equations were of the form:

$$PC_i = a + bICQ_i + cBETA_i + u_i$$

and

$$PC_i = a + bICO_i + cBETA_i + u_i$$

where: PC_i is the price change (as defined above) in period i;

ICQ_i is the change in open interest relative to NYSE volume;

ICO_i is the change in open interest relative to shares outstanding;

BETA is the 5 year Merrill Lynch beta coefficient.

The results indicate an inverse relationship between change in open interest and stock price. Of the twelve regressions performed, ten yielded negative coefficients for b, five of them significant at the 95 percent level. The report warns against concluding that change in open interest is the cause of price declines or advances, and suggests that the direction of causality may be just the reverse. Declining stock prices may cause investors to increase the number of options outstanding because they may believe that the stocks are undervalued or are attracted to the option market by the lowered premiums. The analysts note that if stock prices were not serially independent during the time intervals, then it is quite likely that the direction of causality is reversed; they proceeded to test for serial

correlation using the VonNeumann ratio and the Durbin-Watson statistic for stationary time series. Both of these measures indicated positive serial correlation for each time period, thus casting doubt on the responsibility of open interest changes for the observed price changes.

Another test performed attempted to determine the possible effect on daily price movement in underlying stocks during the expiration week. Since the majority of all exercises occur in the final days before expiration, the test attempted to measure the effect, if any, such exercises have on the underlying stock. The time periods covered by the study were the last five business days prior to the expiration date for three expiration periods in 1973 and 1974.

As in the previous test, a market adjusted price change is determined for each stock, but in this case it is a one-day change. Exercises on an underlying stock are expressed relative to the corresponding NYSE volume for the security and to the number of shares outstanding. A cross-sectional regression analysis was employed with both same day and lagged variables. The estimated regression equations were of the form:

$$PC_{it} = a + bEQ_{it} + cEQ_{it-1} + dBETA_i + u_i,$$

and

$$PC_{it} = a + bEO_{it} + cEO_{it-1} + dBETA_i + u_i$$

where: PC_{it} refers to the price change of stock i on day t;

EQ_{it} is the number of exercises for stock i on day t, adjusted for volume;

EQ_{it-1} is the number of exercises for stock i on day t-1, adjusted for volume;

EO_{it} is the number of exercises for stock i on day t, adjusted for shares outstanding; and

EO_{it-1} is the number of exercises for stock i on day t-1, adjusted for shares outstanding.

The results were largely inconclusive in that no consistent relationship was found. Only three out of 24 regressions showed significant coefficients for exercises. The study concluded that there was no systematic relationship between daily exercises and daily stock price changes.

A final test of note attempted to determine the possible effect on daily price movement in underlying stocks during the expiration week due to size of open interest. Total open interest figures for the CBOE and other option exchanges are published each day in newspapers along with price information, but open interest is not broken down by option class. In fact, these figures are not available until late on the following day, when they are released to CBOE member firms. This test was an attempt to determine whether the price of the underlying stock on any given day of the expiration week might be related to the release of information on the open interest of several preceding days.

The methodology used was very similar to the two preceding tests. A cross section of all stocks was used and regressions were performed for each day of the test period relating price changes in underlying stocks to open interest of the two preceding days. The results showed only three out of 18 significant coefficients for the open interest variable. They therefore concluded that the release of open interest information does not cause (nor is it related to) price changes in the underlying securities.

A critique of the Nathan study includes some methodological and limited data problems as well as the obvious fact of its age (1974) relative to the tremendous growth and changes that have taken place in the options markets since then. The study examined only 16 securities during the July and October 1973 and the January 1974 expiration periods, the first three of the CBOE's existence. Given the growth and development of options since 1974, it would be inappropriate to assume the same conclusions would pertain to more recent expiration periods. The methodology is limited in that it only considers cross sectional data of all stocks and does not look at the effect on individual stocks. Also, the test period is too short (only 3 expiration periods) to make any reliable conclusions. Therefore, even though the statistical methods described above are valid, they are possibly not the best tests for measuring

the hypothesized relationship between options and stock price movements.

Chicago Board Options Exchange Study (1975)

Two follow-up studies performed by the CBOE were undertaken to update the Nathan study. Their intent was the same in that they attempted to determine whether or not options affect the market for the underlying stocks. They generally followed the same methodology as used in the earlier Nathan study and they for the most part reached the same conclusions. The first update (CBOE, 1975) covered the time period of December 30, 1974 to April 30, 1975. This particular period was chosen because it offered a contrast to the period used in the Nathan study. During the Nathan study period the market was in a general downtrend while this study used a time period which saw the NYSE composite index increase by about 30%. Also, CBOE volume and open interest had increased about 400% between the end of the Nathan study period and April 1975. In this study's repeat of the test to determine if there was a relationship between option exercises and daily price movements in underlying stocks during expiration weeks, the results were similar. The conclusion, as before, was that there was no consistent or discernible pattern of price behavior of the underlying stocks due to exercise activity. The study also concluded, as did the Nathan report, that there was no discernible

relationship between reported changes in open interest and daily price movements in the underlying stocks during expiration weeks.

Chicago Board Options Exchange Study (1976)

The second update (CBOE, 1976) was similar to the first one except that the study period was changed to include December 31, 1975 to January 16, 1976. This period witnessed a sharp increase in stock prices, a record level of volume in both the stock and option markets, a doubling of open interest compared to a year earlier and a record number of exercises. The CBOE felt that because of this period's record option activity, it would provide a good test of the effects, if any, that the options market exerted on the stock market around an expiration date. Nevertheless, the results were very similar to the first update, with no evidence of abnormal price behavior in the underlying stocks being found.

In summary, the Nathan report and the two CBOE studies indicate no statistically significant relationship between option trading and the price behavior of the underlying stocks. They conclude that the options market exerts virtually no harmful effect on stock prices. However, these studies suffer from some methodological and data problems as mentioned previously and they are not in agreement with the

opinions of several specialists on the NYSE, as well as more recent research on the topic.

Evidence of an Option Expiration Impact

It appears to many traders close to the market that the "tail is wagging the dog." "There is no doubt options pull down such stocks as IBM, Xerox and McDonalds," says Richard Rosenthal, a partner at Salomon Brothers (Lenzner, 1976, p. 5). Arthur de Cordova, the NYSE IBM specialist, said (referring to the July 1976 expiration week), "People who previously bought the stock and sold the July option, sold the stock last week and closed out the option. The selling of the stock held IBM down" (Pacey, 1976, p. 40). Irwin Guttag, a partner at Kaufmann, Alsberg & Co. asserts, "Options definitely accentuate the short-term moves in stocks. I see it all the time" (Lenzner, 1976, p. 6). (The next section of this paper attempts to explain why the above quotes are made or why the existence of options can cause abnormal stock price behavior, especially around the expiration date.)

The CBOE, with their studies as evidence, disagreed with these contentions. "Options don't have an effect on stocks. The stocks are the cause and the options market feels the results," said Joseph Marconi, a spokesman for the CBOE (Lenzner, 1976, p. 6). The Securities and Exchange Commission, also, had some misgivings about the validity of

the results of the Nathan and CBOE studies as well as some problems with option selling practices and surveillance, and, with the urging of some of the critics of the options market, put a freeze on further growth of option listing in 1977. The SEC then began a comprehensive investigation of the options markets which resulted in the Special Study of the Options Market (SEC, 1979) released in early 1979. The study found some weaknesses and problems areas in the options markets but none severe enough to continue the freeze, so it was lifted in late 1979. In regard to the topic of this paper, the SEC study cites evidence of increased stock price activity just prior to option expirations and describes trading situations which could cause such activity. (More on this in the next section.) During the period of the freeze, when there was no clear concensus as to whether options trading affected the underlying stocks around the expiration date, two studies appeared which seemed to refute the findings of the Nathan and the CBOE studies. They found that there are discernible interactions and correlations between options and stock prices around expiration dates.

Kopprasch Study

The first of these was a Ph.D. dissertation by Robert Kopprasch (1977). His paper attempted to determine whether the exercising of options in the period immediately

preceding expiration exerted a measurable impact on the prices of the underlying stocks. Kopprasch was basically running the same test as in the Nathan Report but with a different methodology. The expiration periods chosen were January and April 1975 and January 1976. These were the same periods analyzed by the CBOE in their study, where no impact was found. Regression analysis and Spearman rank correlation were employed to measure the possible relationship between exercises and market adjusted price changes in underlying stocks. The market was measured by both the Dow and the Standard & Poor 500 index; risk was adjusted for by using each stock's beta in the context of the CAPM. On a cross-sectional basis, measuring intervals of the last seven days and the last four days prior to expiration were used to define the total exercise and price change variables. Exercises were deflated by both shares outstanding and volume.

The results of this study contradict the conclusions of the previous Nathan and CBOE studies. The results of the cross-sectional regressions are shown in Table 1. Significant regression coefficients were obtained for many of the tested relationships for both January 1975 and 1976. In January 1975, the relationship between the number of exercises and relative price performance was negative, i.e., a high level of exercises was associated with poor price performance, and vice versa. However, in January

Table 1. Kopprasch's Regression Results

Expiration Month	Time Frame Relative to Expiration	Effect on Price	Comments
January 1975	Last 7 days	Negative	Statistically significant at .05 for one variable pair (out of 8).
	Last 4 days	Negative	All beta-weighted variables significant at .05 or less.
April 1975	Last 7 days	Mixed	Not statistically significant.
	Last 4 days	Negative	Not significant; Spearman correlations significant at .07 for volume-related variables.
January 1976	Last 7 days	Positive	Unweighted: significant at less than .05. Spearman correlations significant at less than .01. Beta-weighted: significant at less than .10. Spearman correlations significant at less than .03.
	Last 4 days	Positive	All volume-related prices significant at less than .05.

1976, there was a direct relationship. Kopprasch suggests that the direction of the results was a function of the type of exercise (arbitrage or simply to obtain the stock) and whether the call seller was covered or naked. In other words, during the January 1976 expiration period he suggests that since the general market was up sharply during January, many option sellers were naked in-the-money options and option buyers were exercising to acquire the stock. The lack of selling the stock upon exercise and the purchasing of stock to cover the naked shorts caused the positive relationship. Whereas, different market conditions preceding the January 1975 expiration period resulted in fewer naked shorts and more arbitrage situations.

No significant effect was found during the April 1975 period and the direction of the effect was mixed. These results were found for both the seven and four day periods, and were confirmed by the rank correlations. Although, on a cross-sectional basis, many of the tested relationships were significant at the 5% level, the R-squares of the regressions were rather low, indicating that variations in the stocks' performance were not adequately explained by the exercise variable alone. The low R-squares may be explained by the results of the regression of each individual stock's daily exercises and daily price performance. Regardless of the direction of the effect for the cross section of all stocks, individual stocks were

affected both up and down in a rather random fashion in each period tested. However, when the effect was significant for individual stocks, the R-square values were typically close to or higher than .90. Kopprasch concludes from this that, although there is no systematic pattern of effect, based on the number of significant regressions, with the associated high R-square values, and the significant rank correlations, the option exercises are closely related to, and may cause, the relative price performance of the individual underlying stocks.

Klemkosky Study

The second study which produced results opposite to the Nathan and CBOE studies was by Klemkosky (1978). He also investigated the effect of option expirations on underlying stock prices. Instead of regressing some independent variable such as number of exercises against underlying stock price performance as Kopprasch did, Klemkosky simply analyzed the residual return behavior of the stocks in the expiration week and the week following expiration. He was looking for abnormal returns as proof that option activity during this period caused this return behavior. After discussing some of the factors that might cause options to affect stocks, he hypothesized that option expirations adversely affect underlying stock prices in the expiration week. If the above hypothesis is true and downward price

pressure is evident in the expiration week, it should be corrected in the subsequent week. So he also hypothesized that underlying stock prices will on average exhibit positive price changes in the week following option expirations.

The study covered 14 expiration periods in 1975 and 1976 and involved 76 stocks with options listed on the CBOE making it more comprehensive than any previous studies. The methodology used in the study was residual analysis of the market model returns. Weekly returns (week ending the third Friday of the expiration month when trading ceases in an expiring series) were computed for the underlying stocks and the market. A 50 week time series of security and market returns prior to the expiration week was used to estimate the parameters, A_i and B_i, for each security. These parameters were then used to compute the estimated residual error terms. The error term serves as a measure of the risk-adjusted return of the security after removal of the general market effect.

Klemkosky, after computing the residuals for each individual stock for the expiration week and the week following, found the cross-sectional average of the residuals. His results are shown in Table 2. The average residuals seem to support the hypothesis that options negatively affect underlying stock prices in the expiration week. They were negative in 12 of the 14 expiration weeks

Table 2. Klemkosky's Average Residual Returns for Expiration and Subsequent Week.

Expiration Date	No. of Securities	Expiration Week			Subsequent Week		
		ARe	Std. Dev.	t Value	ARs	Std. Dev.	t Value
Jan. 1975	32	-.0151	.0495	-1.736*	.0213	.0561	2.147*
April 1975	39	.0025	.0411	0.380	.0070	.0270	1.628**
July 1975	46	-.0096	.0430	-1.514**	.0089	.0297	2.032*
Oct. 1975	46	-.0142	.0379	-2.513*	.0039	.0385	0.679
Jan. 1976	46	-.0029	.0354	-0.558	.0027	.0361	0.509
April 1976	46	-.0079	.0239	-2.257*	.0029	.0299	0.659
July 1976	46	-.0079	.0267	-2.026*	-.0072	.0279	-1.756*
Oct. 1976	46	-.0089	.0184	-3.296*	-.0049	.0294	-1.139
Aug. 1975	19	-.0107	.0375	-1.224	.0001	.0361	0.012
Nov. 1975	30	-.0101	.0355	-1.559**	.0025	.0323	0.424
Feb. 1976	30	-.0178	.0383	-2.546*	.0010	.0362	0.152
May 1976	30	-.0124	.0345	-1.968*	.0113	.0226	2.736*
Aug. 1976	30	-.0135	.0460	-1.607**	.0032	.0223	0.780
Nov. 1976	30	.0034	.0350	0.531	.0005	.0312	0.088

*Significantly different from zero at the .05 level.

**Significantly different from zero at the .10 level.

and significantly negative in ten of the periods. The average residual price change in the expiration week was approximately -1.0 percent.

The aggregate residuals in the week following expiration seem to support his second hypothesis of a positive effect in this week. However, the results are not nearly as significant as for the expiration week. The average residuals were positive in 12 of the 14 weeks but significantly positive in only 4 of the periods. The average residual price change in the subsequent week was +0.4 percent.

Klemkosky also analyzed each individual security's residual return behavior in the expiration and subsequent week. Fifty-four of the 76 companies (71%) had a negative mean residual in the expiration week, and 44 companies (58%) had a positive mean residual in the week following expiration. (The fact that not all residual returns consistently followed the majority pattern indicates a need for further research on why some stocks are affected differently than others.) The null hypothesis that the proportion of negative mean residuals and positive mean residuals was equal to 50% was rejected for the expiration weeks but not for the subsequent weeks. Also, in the aggregate, the 76 securities were involved in a total of 516 expirations during the period of study. The expiration weeks experienced 309 negative residuals and 207 positive

residuals. Again, the null hypothesis that the proportion of negative and positive residuals equals 50% was rejected for both the expiration and subsequent weeks, further supporting the aggregate cross-sectional results.

Klemkosky (1978, p. 518) concludes,

> The results of this study show that in the aggregate the price behavior of the underlying common stocks was affected by an expiring series of options. This impact is strongest in the expiration week when the average residual return approximated a negative 1.0 percent. While seemingly not large, it must be remembered that this is a weekly change and an underlying stock is exposed to four expirations each year. A partial adjustment occurred in the subsequent week as the average residual return was a positive 0.4 percent. These results would appear to contradict the statistical implications of the "weak form" efficient market hypothesis in that the average residuals returns were predictable in the expiration and subsequent week.

Summary and Need for Further Research

This review of the literature points out that there is disagreement among researchers as to the effect of option trading on the underlying securities. However, the more recent studies (Klemkosky, 1978; Kopprasch, 1977) have generally concluded that there are some statistically significant relationships between options and underlying stock prices around the expiration date. But, these recent studies are deficient in certain areas, and further study is warranted. One study (Kopprasch, 1977) found no consistency in the effect, both on an aggregate and individual

stock basis. The study did not attempt to explain in any detail or test for the reasons causing these differing effects. The other study (Klemkosky, 1978), while finding a negative effect on aggregate stock prices the week prior to expiration and a positive effect the week following, did not consider daily price change effects on the underlying securities. The use of weekly data may be hiding some significant results that are occurring on a daily basis. Nor did the study attempt to determine what factors may be causing certain individual stocks to exhibit very high abnormal returns while others were virtually unaffected.

As mentioned before, Klemkosky, using weekly data, found negative abnormal price behavior in the expiration week and positive behavior in the following week. This study will further refine his work by using daily price changes for the 10 day period surrounding the expiration date to attempt to pinpoint the day or days with the largest impact. Also, by using regression analysis techniques, this study will attempt to determine what factors cause the greatest abnormal performance on an individual stock basis.

The next chapter describes the theory behind an expectation of a negative market reaction in the one or two days prior to expiration. From this theory will follow several testable hypotheses that suggest a functional relationship between the expected negative abnormal returns

(the dependent variable) and several observable variables (the independent variables).

CHAPTER III

THEORETICAL BASIS FOR CAPITAL MARKET REACTION TO THE OPTION EXPIRATION

The literature review in the previous section has given some evidence that the existence of options can increase activity in and generate abnormal performance in underlying securities around the expiration date. This section will discuss the key factors and market dynamics that cause this abnormal stock price behavior. Almost all of this unusual option-induced price behavior probably occurs in the final days before expiration. This is because as maturity approaches, the time value of the option approaches zero causing options to trade at approximately their intrinsic values. Therefore, the vast majority of all exercises are tendered by option buyers during the final trading week, because prior to that time, it would have been more profitable to simply sell the option in the secondary market where the time value could have been realized as well as the option's intrinsic value. Also, if an exercise does not occur, all other option positions are closed out during the final days prior to expiration via a closing transaction. The close relationship between the option price and its underlying stock price, the converging of the option's intrinsic value with the market

value, the large number of closing transactions and exercises and the potential for large profits in options with only a small price move in the stock create an environment for traders to both unintentionally and intentionally influence stock prices. With this as background, what situations or actions by traders and the general investing public might cause or contribute to abnormal behavior in the underlying stocks around the expiration period?

Position Unwinding

As the expiration date approaches, a dramatic increase in position unwinding is carried out by both option buyers and sellers. For the option buyer who is a market maker on the floor of the exchange, if he exercises his option, the stock acquired by him from the writer can be and is normally immediately sold, creating downward pressure on the underlying stock price. (For the arbitrageur, this buying of the call, and immediate exercise and sale of the stock generates profits as will be discussed shortly.) Of course, if the option writer is naked the option, he will have to go into the market and buy the stock if his option is exercised. This will offset the downward pressure mentioned above.

As a further example of how the unwinding of a long call option might depress the underlying stock, consider a stock trading at 30-5/8 on the expiration Friday. Most

holders of calls that allow them to buy the stock at 30 will choose to sell the options to a market maker on the exchange floor rather than exercise. But, the market maker is not anxious to exercise his newly acquired options either, and will sell borrowed shares of the underlying stock short to hedge his position. This selling pressure in the stock will push its price toward 30, at which point the call holders will no longer be able to get anything for their options and will stop selling.

However, if puts are traded on the underlying stock, there could be an opposite effect. If the stock is selling somewhat below 30, the market maker will be buying puts, hedging that position by buying stock and therefore creating upward pressure on the stock price. Consequently, the large increase in the number of stocks with puts being traded beginning in early 1980 would be expected to diminish the abnormal negative returns found by researchers using pre-1980 data. This hypothesis will be detailed later in Chapter IV which deals with hypotheses suggested by the theory.

Position unwinding by option sellers can also create downward pressure on the underlying stock price. Many investors buy an underlying stock for the sole purpose of being able to sell call options on that stock. As expiration approaches, several actions might be taken by the investor. If the price of the underlying stock is less

than the exercise price of the option, the writer knows with some certainty that the option originally sold will not be exercised and expire worthless because it has no theoretical value. Therefore, any position in the underlying stock undertaken simply to cover the writing of the call can be sold in the final days before expiration since it is unlikely that the investor will receive an exercise notice. Of course, the degree of this likelihood and the decision to sell the stock depend on how close the stock price is to the exercise price and the amount of risk the investor is willing to take.

If the underlying stock price is greater than the exercise price, it normally is advantageous for the writer to close out his option position during the final trading days before expiration as this is when he can buy them back at the lowest possible price. This is because there is little time value left in the option near expiration. And if the investor bought the stock solely to write options on it, his closing purchase transaction would be accompanied by selling the underlying stock, again exerting downward pressure on the stock.

In summary, to the extent that stock positions are held for the sole purpose of writing covered calls or for hedging option positions, the expiration of said options eliminates the need for holding the stock. And, the

resulting sale of the stock during the days just prior to expiration exerts greater than normal downward pressure on its price.

Arbitrage

Arbitrage transactions involve the simultaneous or nearly simultaneous purchase and sale of the same or equivalent securities at different prices to take advantage of generally small price disparities. These disparities normally arise in the prices quoted for related securities in different markets on which these securities are traded. Since the pricing inefficiencies are usually very small, only traders who pay little or no transaction costs will be able to profit from it. Also, these pricing differences usually exist only beiefly before they are recognized by market professionals whose transactions tend to eliminate these differences. There are several situations where options provide arbitrage opportunities that have an end result of putting downward pressure on the underlying stock price.

The most common and probably most straightforward situation is when an option sells for less than its intrinsic or theoretical value, that is, the option premium plus the exercise price is less than the market price of the stock. This occurs quite frequently immediately before expiration, because investors may drive the option price

below its intrinsic value because it is normally more profitable to sell the option rather than exercise it. Selling the option avoids paying the commission costs involved in exercising, acquiring the stock and selling it in order to liquidate the position. At any rate, this presents an arbitrage opportunity: the option is purchased, immediately exercised and the stock is sold in the market. For example, assume a stock is selling for $52 and an option to buy this stock at $50 is trading at $1-7/8. A market maker who pays no transaction costs, can buy the option at 1-7/8 and simultaneously sell the underlying stock short. He has locked in a profit of $12.50 on each 100 shares traded as he uses the stock called at $50 to cover the short position. The short selling action will, on net, put downward pressure on the stock price, assuming the option writer receiving the call notice is not "naked" which would cause him to buy stock in the market and cancel out the effect. The option arbitrage described above is theoretically available to anyone, but as a practical matter is practiced only by option exchange members who can trade commission free and who can respond quickly by executing orders in different markets.

Two other arbitrage trading strategies, discussed in the Securities and Exchange Commission's (1979) Special Report on the Options Market, also could create downward pressure on the underlying stocks just prior to expiration.

These strategies take advantage of pricing inefficiencies between the price of a call option and the price of a put option with an identical exercise price and expiration date. Again, these arbitrage techniques are done by market makers and "upstairs firms" because they pay no commissions and because they are ideally situated to monitor the entire options and stock marketplace to identify "conversion" and "reverse conversion" opportunities and to act on them quickly.

Conversion arbitrage can be accomplished if a call is overvalued relative to its corresponding put. It is used as a riskless method of capturing the amount by which the prices are out of line. The conversion equation is as follows: long stock (100 shares) + short 1 call + long one put = no market risk. If an investor establishes this position and holds the position until expiration of the options involved, there is no market risk and at expiration, regardless of the direction of movement in the stock price, the entire position will be eliminated for the profit which existed when the position was established.

If the short calls expire in-the-money, they will be exercised by the holder and the recipient of the stock generally will sell the securities in the marketplace. If the long puts expire in-the-money, they will be exercised by the investor which again will result in the stock being delivered out of the firm. In either case the

out-of-the-money options will expire worthless and the long stock will be delivered out of the firm and probably sold by the recipient, resulting in downward pressure on the stock price. The position will produce a profit if the net proceeds from selling the call and buying the put exceed the cost of carrying the stock until the expiration date.

For example, assume XYZ stock is trading at $50 and the XYZ 50 calls one month prior to expiration can be sold at $3 and the corresponding XYZ 50 puts can be bought at $2. Assume the investor's cost of money is 12%; therefore, the cost of carrying 100 shares of stock until expiration will be $5,000 x 12% x 1/12, or $50. The profit from the conversion arbitrage is as follows:

Proceeds		less	Cost	=	Profit
Sell call	+ $300				
			$50.		$50.
Buy put	- $200				
	+ $100				

A reverse conversion arbitrage is advantageous when a call is undervalued relative to its corresponding put. Again, it is a riskless method of capturing the amount of this undervaluation. The position is the reverse of the previously mentioned technique in that it involves short stock + long call + short put. Again, the position will be eliminated at expiration, regardless of the direction of the stock price move, for the profit which existed when the position was established. The position will be profitable

whenever the interest which can be earned on the proceeds from the short stock sale exceeds the net cost of the long call, short put position.

For example, assume that XYZ stock is trading at $50 and that the XYZ calls which expire in one month are undervalued with respect to the puts. The calls are trading at 2-1/2 and the puts at 2-1/8. If the firm sells the stock short, it can earn $50 in interest income for each 100 shares sold ($5,000 x 12% x 1/12). The profit is as follows:

Proceeds	less	Cost		Profit
$50.		Buy call	- $250	
		Sell put	+ $212.50	$12.50
			- $ 37.50	

The strategy is really only viable for firms with a significant retail business who can borrow customer margin securities at no cost to satisfy short stock sale delivery requirements. It should be noted that conversion and reverse conversion arbitrage opportunities are only available for the approximately 150 stocks which have both listed puts and calls. Also, in practice, the arbitrage transactions themselves may bring prices back into line fairly quickly, thus limiting the potential profits. However, the key point here is that the arbitrage activities described above generally result in selling pressure on the underlying securities in the last few days prior to expiration.

Manipulation

The discussion above regarding position unwinding and arbitrage focused primarily on the legitimate use of options and the resulting unintentional byproduct of abnormal price behavior in the underlying stocks. Additionally, however, abnormal price behavior in the underlying stocks may occur in the final days before expiration due to intentional manipulation. Manipulation is defined as attempting to influence the price movement in a stock to benefit a previously established options position. The incentive for manipulation is especially great in the last few days before expiration because a relatively small commitment of capital to an options position can result in huge percentage gains if a favorable move in the stock takes place. Also, there is not much incentive for manipulation other than in the final days before expiration because the capital required to effect and maintain a prolonged change in the level of stock prices is beyond the resources of most market participants. The incentive and opportunity for traders to attempt manipulation is demonstrated by the following case uncovered by the Securities and Exchange Commission (1979). A CBOE marketmaker in July, with IBM stock trading around 260, was short approximately 200 July 260 calls. The value of his short position would be enhanced if, by depressing the price of the stock, he could cause a corresponding drop in the price of the July 260

calls. To accomplish this goal, the marketmaker purchased 50 deep-in-the-money calls (the July 240s) and exercised them. He then increased his short position by 100 calls in the July 260s at prices ranging from 2-7/16 down to 2-1/4. Within a few minutes he sold the 5,000 shares of IBM stock acquired through exercise of the July 240s at declining prices ranging from 260-1/2 down to 259-1/2. The options market quickly reacted to the decline in the IBM stock and the July 260s declined in price, permitting the marketmaker to profitably cover, within a matter of minutes, a substantial part of his short position in the July 260 calls at prices ranging from 1-7/8 to 2-1/16. While the dollar profit from closing his short options position was relatively small (generally less than 1/2 point per option), the profit represented a percentage gain of between 20-25 percent.

Because only a small move in the underlying stock may result in large percentage gains in the related options, manipulation may even be accomplished without the trader actually engaging in stock transactions. He could move the stock price to a certain extent merely by placing a large order just above or below the market which could briefly influence the price of the stock in the desired direction. Effecting stock transactions to depress or prevent a rise in the price of a stock in order to prevent near-the-money or slightly in-the-money calls from being exercised, and to protect a previously received permium, is referred to as

"capping." Capping can be accomplished as demonstrated in the previous example or by selling stock short or merely by placing large orders just below the current market price. Similarly, "pegging" is an attempt to prevent a decline in a stock price or to support the price, in order to assure that put options will not be exercised and to protect previously received premiums. These practices are most likely to occur just before expiration when the probability of exercise is highest.

Manipulation is difficult to prove because many legitimate strategies involve stock and option transactions and manipulative intent cannot be established simply by showing that a trader held both options and related stock. There is also the difficulty of precisely reconstructing the actual timing of related stock and options transactions. Transactions which appear to be done with the intent of benefiting a position in one options series may be explained as necessary to carry out some legitimate trading strategy. The key point, with regard to this paper, is not whether manipulation can be clearly proved or not but rather that there exists strong motivation to manipulate in the last few days prior to expiration and that it probably occurs even though the evidence may be circumstantial in many cases.

Summary

In summary, Chapter III has given examples of practices and situations in which the mere existence of options may affect the prices of the underlying securities in the period just prior to the expiration date. These practices and situations have generally been shown to have a depressing effect on the stock price just prior to expiration if only calls are traded. With the advent of put trading on the majority of optioned stock, this negative effect on stock prices would be expected to be diminished.

CHAPTER IV

HYPOTHESES SUGGESTED BY THE THEORY

With the literature review in Chapter II and the theory just discussed in the previous chapter as support, several testable hypotheses are now suggested. Four observable firm specific variables are suggested for inclusion as independent variables in the subsequent tests. These variables, which will be incorporated into the hypotheses that follow, are: (1) stock volume, (2) option volume, (3) is the option dually listed? and (4) are puts traded on the stock in question?

Hypotheses Regarding Daily Returns

Null Hypothesis

No risk-adjusted abnormal returns, negative or positive, should be observed for an optioned stock during the ten days surrounding the option expiration.

This hypothesis is based on the premise that the market is efficient, with the market being considered efficient if prices fully reflect all available information. This includes information relating to option expiration effects. In other words, as suggested by Fama (1970), the market is a "fair game" with respect to all known

information that may affect the stock price. The null hypothesis implies that all the aforementioned option expiration effects on stock prices are known by investors and therefore, the stock prices will already fully reflect this information.

Alternative Hypotheses

1. Risk-adjusted negative abnormal returns should occur in the week preceding the expiration date. As the test will be run using daily data, it is further hypothesized that the negative abnormal returns will be greatest on the Thursday and Friday prior to expiration.
2. Market equilibrium should return in the subsequent week as the expiration pressures will have ended. Therefore, positive abnormal returns should occur.

These hypotheses are based on the rationale presented in Chapter III.

Hypotheses Regarding Determinants of the Abnormal Returns

Position Unwinding Theory

As stated previously, to the extent that option writers are "covered" and puts are few and lightly traded, the net effect of position unwinding is negative on the underlying stock. Therefore, the greater the amount of

position unwinding, the greater should be the negative impact on the underlying stock. An observable variable that could act as a surrogate for the extent of position unwinding is the level of option volume during the week prior to expiration. Therefore, the following hypothesis is suggested:

H_1 = The size and sign of the abnormal returns in the week prior to expiration are a negative function of the extent of option volume in that week. (However, the significance of this functional relationship should decline beginning in mid-1980 when puts trading began to expand rapidly. See hypothesis regarding puts on page 46.)

Arbitrage Theory

It was shown previously that arbitrage activity can, on net, have a negative impact on the underlying stock. For arbitrage activity to be successful requires a liquid market with substantial breadth and depth in both the market for the option and the stock in question (Pacey, 1982). Observable variables that could act as surrogates for the extent of arbitrage activity are option trading volume and stock trading volume. Therefore, the following hypothesis is suggested:

H_2 = The size and sign of the abnormal returns in the week prior to expiration are a negative function of the extent of stock volume and, again, option volume.

Manipulation Theory

If one assumes some manipulation is taking place, and this manipulation results in abnormal price behavior in the underlying stock, then the question arises as to which stocks will have the greatest tendency to be manipulated. From the discussion in the previous chapter, it would appear that manipulation profits are small per position held, i.e., the trader is content to skim off 1/16 or 1/8 points per contract held. Therefore, to make it worthwhile and to actually affect the price of the stock, large size positions would need to be entered into. This again suggests that negative abnormal price behavior, this time due to manipulation, would be accompanied by greater than normal volume in both the stock and option and high open interest. Therefore, an hypothesis similar to the one offered under arbitrage theory could be suggested.

Therefore, high option and stock volume creates an environment for market participants to profitably engage in arbitrage and manipulative activities, and high volume is a good indicator that this type of activity is indeed taking place.

The Existence of Puts

As previously mentioned, there was a large expansion in puts trading beginning in mid 1980. Puts, in most respects, are the mirror image of calls. Consequently, the hypothesized negative abnormal returns in the underlying stocks due to the expiration of calls could be expected to be eliminated or negated to some extent if puts are traded on the same underlying stock. Therefore, the following hypothesis is suggested:

H_3 = The size and sign of the abnormal returns in the week prior to expiration are positively related to the existence of puts.

Dually Listed Options

Approximately 10 percent of all exchange listed options are dually listed, which means the options are traded on more than one exchange. The presence of multiple markets would be expected to increase the opportunity for traders to find profitable arbitrage situations. As shown previously, arbitrage activity can, on net, have a negative impact on the underlying stock. Therefore, the following hypothesis is suggested:

H_4 = Stocks, whose options are dually listed, will exhibit negative abnormal returns that are greater than non-duals. Or, the size and sign of the abnormal returns

in the week prior to expiration are a negative function of the presence of dually listed options.

The hypotheses that have been suggested in this chapter are summarized in Table 3.

Table 3. Predicted Overall and Cross-sectional Effects on Underlying Stock Prices Due to Option Expirations

Predicted Overall Effects		
	Dependent Variable	
	Abnormal Returns During 5 Days Prior to Expiration Date	Abnormal Returns During 5 Days Subsequent to Expiration Date
Predicted Direction	-	+

Predicted Cross-sectional Differences in the Magnitude of Abnormal Returns	
	Dependent Variable
Independent Variable	Cumulative Abnormal Return for the Expiration Week
Option Volume	-
Stock Volume	-
Existence of Puts	+
Dually Listed	-

CHAPTER V

METHODOLOGY

This section details the sample used, the time period of the study, the variables used in the tests and the general methodology. The methodology used to test for the capital market effects hypothesized previously involves a sequence of two tests. The first test is a residual analysis which will test for the presence of abnormal returns in the days surrounding the option expiration. The second test will employ a cross-sectional regression model where significant abnormal negative returns found in the first test will be regressed on the observable variables suggested by the hypotheses discussed previously.

Sample Selection

The sample consists of a subset of the 227 stocks which had options traded on the four major options exchanges as of the end of 1981. These exchanges are as follows: Chicago Board Options Exchange, American Stock Exchange, Pacific Stock Exchange and the Philadelphia Stock Exchange. The set of all stocks with exchange listed options was reduced two ways. First, only those stocks with options expiring in cycle 1 and 2 were included in the sample. (Cycle 1 = January, April, July, October; Cycle 2 =

February, May, August, November; Cycle 3 = March, June, September, December.) Cycle 3 optioned stock were omitted because this cycle was first used in 1979 and therefore, no cycle 3 options were traded over the entire test period, 1978 through 1981. Second, any stocks that, for one reason or another, did not have options listed over the entire four year test period were deleted. There were 30 stocks in this category. The majority of these deletions were options that became listed subsequent to the lifting, in early 1980, of the Securities and Exchange Commission freeze on option listing expansion.

Consequently, of the 227 optioned stocks at the end of 1981, 138 are included in the sample, 73 stocks having options with cycle 1 expirations and 65 having cycle 2 expirations. All of the 138 firms in the sample are large Fortune 500 firms. Therefore, it appears to be unnecessary to further delete firms due to firm specific characteristics that might bias the test results.

Time Period of Study

The general time period of the study is a four year period from 1978 through 1981. This period was chosen for two reasons. First, it is a more recent time period than previous research in this area and second, it encompasses a period of change in the options market. Specifically, there was a substantial increase in the number of options

listed and a resulting increase in volume. Also, there was a large increase in puts trading during this time period.

Each expiration cycle involves 4 expirations per year. Therefore, as data are being used for 2 cycles, a total of 32 expirations are involved in the tests over the four year test period. This should provide a large enough sample of returns around the expiration dates to preclude the possible conclusion that any abnormal returns found were due to factors other than the expiration event. In other words, a finding of negative abnormal returns in the days prior to expiration over 32 event periods is more conclusive than over, say, 4 or 5 event periods.

Variable Definition and Measurement

Dependent Variable

The variable to be explained in the second stage cross-sectional tests is the cumulative abnormal residual for the five days prior to expiration. This five day period begins on Monday and ends on Friday of the expiration week. The estimates of the cumulative abnormal residuals were calculated using a market model approach which will be explained shortly. These 5 day cumulative abnormal residuals are denoted as $CAR_{j,t}$ for firm j, in test period t.

Independent Variables

The explanatory variables that were discussed earlier in the study are defined as follows:

Option Volume.

$$OV = \frac{\frac{OVolume_{ew}}{OI_{ew}}}{\frac{\Sigma OVolume/10}{\Sigma OI/10}}$$

where: $OVolume_{ew}$ = the option volume in the expiration week.

OI_{ew} = the open interest in the option for the expiration week.

OVolume/10 = the average weekly option volume for the 10 weeks prior to the expiration week.

OI/10 = the average weekly open interest for the 10 weeks prior to the expiration week.

(The option volume for the above variable is the volume for the option whose exercise price is nearest to the underlying stock price at the expiration date. The open interest is the open interest in the option at the beginning of the week.)

Stock Volume.

$$SV = \frac{SVolume_{ew}}{\Sigma SVolume/10}$$

where: $SVolume_{ew}$ = the stock volume in the expiration week.

$\Sigma SVolume/10$ = the average weekly stock volume for the 10 weeks prior to the expiration week.

Puts Trading.

PT = 1 for underlying stocks that have puts traded on them.

PT = 0 if no puts are traded.

Dually Listed.

DL = 1 for underlying stocks whose options are dually listed.

DL = 0 if the options are not dually listed.

Residual Analysis

Several models have been suggested in the literature to measure risk-adjusted abnormal performance. The general methodology, regardless of the model, is often referred to as "residual analysis," as the risk-adjusted abnormal return is based upon the estimated residuals from a regression model. The Capital Asset Pricing Model (CAPM) formulated by Sharpe (1964) and Litner (1965) and the Fama and MacBeth (1973) residual analysis have been used in the literature to some extent. However, this study will not use them because of theoretical and data problems associated with their use. See Roll (1977) for a further elaboration of these problems.

This study will use the market model. It was formulated by Sharpe (1964) and first applied in event studies by Fama et al. (1969) in their study of stock splits and dividends. Since then many researchers have employed a similar methodology to test for market efficiency and capital market reaction to certain events (Brown, 1978; Galai, 1977; Klemkosky, 1978, Pettit, 1972; Pinches and Singleton, 1978, to name a few). The market model is shown as follows:

$$r_{jt} = a_j + b_j r_{mt} + u_{jt}$$

where: r_{jt} = return on security j for period t.

r_{mt} = return on the market for period t.

u_{jt} = stochastic or residual error term on security j for period t. The error term is assumed to comply with the usual assumptions of the general linear regression model.

a_j = intercept value.

b_j = covariance of the returns on the jth security with those of the market portfolio, divided by the variance of the market portfolio's returns.

a_j and b_j are the parameter estimates obtained by the ordinary least squares regression model and b_j is commonly referred to as the beta coefficient. It measures

the relative systematic risk of the security compared to the market portfolio. The residual term, u_{jt}, captures the reaction of the security's return to company-specific information rather than to information about market-wide factors. Company-specific information includes the fact that options may be traded on the company's stock. This is the key non-systematic variable this study is concerned with. Finally, the model assumes that the return on security j is linearly related to the return on the market portfolio.

A daily measure of abnormal performance, then, can be determined by comparing the actual return of a security to the expected return, given the estimated coefficients a_j and b_j and the performance of the market. That is:

$$A_{jt} = R_{jt} - a_j - b_j R_{mt}$$

or

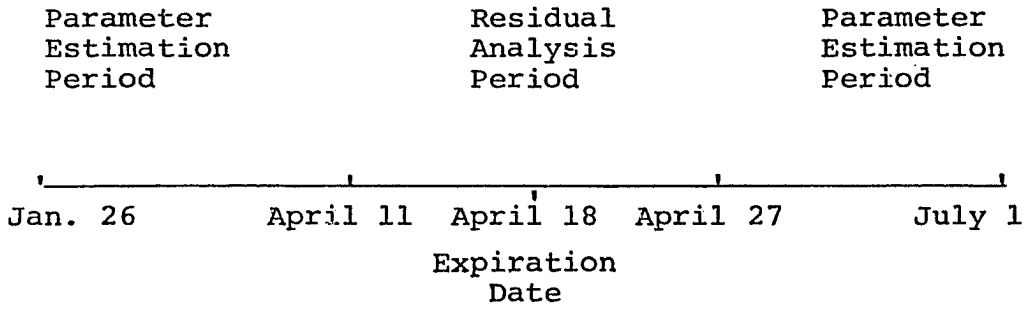
$$A_{jt} = u_{jt}$$

Therefore, if A_{jt} is not statistically different from zero, then abnormal returns are not indicated; if A_{jt} is statistically different from zero, then abnormal returns are indicated. Since the estimates of excess or abnormal returns require that certain parameters be estimated (R_{jt}, a_j, b_j and R_{mt}), the following will be a discussion of the estimation of these parameters.

A ten day event period was defined around each of the 32 expiration dates. Officially, an option expires on the Saturday after the third Friday of the expiration month. The last trading day prior to expiration for the option and underlying stock is the third Friday of the month. Therefore, this will be the critical event date designated in the tests as day zero. The residual analysis period, then, consists of the 4 days before, the day of, and 5 days following the critical event date. This event period should be long enough to capture the expiration-induced market reactions, and yet specific enough to attribute abnormal stock returns to the expiration event. In fact, a key contribution this study makes is in the use of daily data to more specifically determine the effect of the expiration on the underlying stock.

Another important issue is the determination of the estimation period. It should be sufficiently removed from the option expiration dates so as to avoid contamination from any abnormal behavior around the expiration date, but not so removed from that time that the risk of the stock could have changed substantially. Since it has been hypothesized that option expirations affect underlying stock prices, the residual terms may be non-zero around the expiration date. Inclusion of these returns in the regression would violate the regression assumptions and would bias the parameter estimates. To alleviate this problem, a

buffer period of 10 trading days around the expiration date will be set up. This interval will be the analysis period. Since an expiration date occurs every three months for each optioned stock, the parameter estimation period will be approximately 10 weeks or 50 trading days, beginning six trading days after the previous option maturity date, and extending to six trading days preceding the next option maturity date. A schematic example would look as follows:



The estimates of a_j and b_j for the analysis period will be obtained from the prior estimation period. In other words, the parameter estimates for the April 11 through April 27 analysis period will be obtained from the January 26 through April 11 estimation period. However, if it appears likely that the expiration event caused a shift in the parameters a_j and b_j, then, the parameter estimates for the subsequent analysis period (April 21 through April 27) will be obtained from the subsequent estimation period (April 27 through July 10).

With the estimation period defined, there remain the issues of which market index to use and the determination of the actual return on security j. Typically, a broad market index is used, such as the Standard & Poor 500 composite, or the New York Stock Exchange composite index. The choice of the actual index used, the S&P 500, was based on appropriateness and availability. The actual returns on the securities (r_{jt}) will be daily returns including dividends and adjusted for stock splits.

Once the necessary parameter estimates have been obtained, they can be used to find the daily residuals for each security in the sample during the residual analysis period. Then a cross-sectional average of the residuals of all securities in the sample on day k is found by using the following formula:

$$AR_k = \frac{1}{N} \sum_{j=1}^{N} A_{jt}$$

where N is the number of underlying securities in the sample and AR_k is the average abnormal price performance of the underlying securities not explained by the market. In other words, AR_k can be interpreted as the unexpected return on day k on an equally-weighted portfolio of the sampled stocks, given the market return.

Under the assumption that the residuals from the market model are uncorrelated across securities, the t-test for the average residuals for day k is:

$$\frac{\frac{1}{N}\sum_{j=1}^{N} A_{jk}}{\frac{1}{N}\left(\sum_{j=1}^{N}\left[\frac{1}{53}\sum_{t=-60}^{-6}\left(A_{jt}-\sum_{t=-60}^{-6}\frac{A_j}{55}\right)^2\right]\right)^{1/2}}$$

which is distributed Student - t with 54 degrees of freedom.[1]

Cumulative abnormal performance over the ten day analysis periods can then be measured by the cumulative average residual found by using:

$$CAR = \sum_{t=-4}^{+5} AR_k$$

If there are no systematic positive or negative residuals, the value of the C.A.R. should remain at approximately zero.

Multiple Regression Model

If, in fact, it is determined that there is abnormal return performance in the ten trading days surrounding the expiration date, the second phase of the methodology involves developing a model to explain this

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1. The standard deviation of the average performance measure is estimated on the basis of the standard deviation of the performance measure of each sample security in the (-60, -6) period.

behavior. It is expected that the effect of the option expiration will be greater for certain underlying stocks than for others. A multiple regression model is used that has as its independent variables those factors that were discussed earlier that are hypothesized to cause this abnormal behavior. The following regression was used:

$$CAR_{jt} = a_o + a_1 OV_{jt} + a_2 SV_{jt} + a_3 DL_{jt} + a_4 PT_{jt}$$

where: CAR_{jt} = cumulative average residual for the 5 days prior to expiration for stock j in test period t.

OV_{jt} = relative option volume for firm j in test period t.

SV_{jt} = relative stock volume for firm j in test period t.

DL_{jt} = dummy variable--1 if firm j in test period t is dually listed, 0 if not dually listed.

PT_{jt} = dummy variable--1 if firm j in test period t has puts traded, 0 if no puts traded.

CHAPTER VI

ANALYSIS OF RESULTS

Residual Analysis of Daily Returns

The market model regressions were run for each stock in the sample for each of the 32 expiration periods and the presence of abnormal price behavior was determined. A total of 2208 regressions were run (16 cycle 1 expirations x 73 firms, 16 cycle 2 expirations x 65 firms). Table 4 presents some statistics regarding the beta estimates from the regressions. The table shows the average beta or systematic risk of the sample of securities. The table allows a comparison of the beta parameter over the 32 expiration months. As shown, the mean beta values, $\bar{\hat{\beta}}$, are all greater than 1.0 which indicates that optioned stocks are, on average, more volatile than the market.

Shift in Beta

The table also reveals that there is a distinct downward trend in the average beta that occurs beginning in early 1980. The average beta declines from the 1.20 area to the 1.0 to 1.05 area. This downward trend in the average beta coincides with the same time period of a substantial increase in put option trading on the underlying stocks. As a further check, in an attempt to determine

Table 4. The Beta Regression Parameter for Each of the Expiration Periods

Expiration Period	$\bar{\hat{\beta}}$	σ_β	Expiration Period	$\bar{\hat{\beta}}$	σ_β
Jan. 1978	1.229	.4423	Jan. 1980	1.182	.4052
Feb. 1978	1.284	.4219	Feb. 1980	1.215	.4657
Apr. 1978	1.163	.4074	Apr. 1980	1.167	.4062
May 1978	1.196	.4120	May 1980	1.199	.4162
July 1978	1.221	.4309	July 1980	1.084	.3972
Aug. 1978	1.207	.4277	Aug. 1980	1.151	.4157
Oct. 1978	1.224	.4328	Oct. 1980	1.023	.3255
Nov. 1978	1.218	.4326	Nov. 1980	1.091	.3787
Jan. 1979	1.239	.4582	Jan. 1981	1.031	.4018
Feb. 1979	1.223	.4299	Feb. 1981	1.026	.3841
Apr. 1979	1.234	.4933	Apr. 1981	1.034	.3889
May 1979	1.216	.4528	May 1981	1.015	.3867
July 1979	1.208	.4365	July 1981	1.041	.3966
Aug. 1979	1.209	.4878	Aug. 1981	1.038	.3915
Oct. 1979	1.179	.4128	Oct. 1981	1.045	.3985
Nov. 1979	1.220	.4706	Nov. 1981	1.061	.3891

whether puts trading may have contributed to the decline in underlying stock volatility, the change in betas, on an individual stock basis, was compared to whether puts trading was initiated during two comparison periods.

The changes in betas from January 1980 to January 1981 and from February 1980 to February 1981 were observed for this purpose. Table 5 presents the results. The table shows that the majority of underlying stocks whose betas declined 20 percent or more had puts trading initiated during the comparison period, while those underlying stocks whose betas increased 20 percent or more showed only a small percentage with puts trading initiated. Put another way, of the underlying stocks upon which puts began trading, a majority (58% in the January comparison and 63% in the February comparison) had betas that declined 20 percent or more, while a small number (7% in both comparisons) had betas that substantially increased.

The fact that the average beta declines, should not bias the analysis that follows. It is true that the abnormal return (A_{jt}) is affected by a change in beta; however, the direction of the effect depends on whether the return on the market (R_{mt}) is positive or negative. If the return on the market is a random event during the residual analysis period, with equal chance of being up or down on a daily basis, then A_{jt} is randomly affected by the decline in beta. Another factor which mitigates the beta change effect

Table 5. Relationship Between Change in Beta and Presence of Puts Trading

A. Annual Beta Change between February 1980 and February 1981 (Sample Size = 65):

26 betas declined 20 percent or more.
- of these, 17 began put trading during the period (65%)
- of these, 9 did not (35%)

11 betas increased 20 percent or more.
- of these, 2 began put trading during the period (18%)
- of these, 9 did not (82%)

28 betas had changes between ± 20 percent.
- of these, 8 began put trading during the period
- of these, 20 did not

27 Underlying Stocks had put trading begin during the period.
- 17 had betas that declined 20 percent or more (63%)
- 2 had betas that increased 20 percent or more (7%)
- 8 had betas change between ± 20 percent (30%)

B. Annual Beta Change between January 1980 and January 1981 (Sample Size = 73)

28 betas declined 20 percent or more.
- of these, 15 began put trading during the period (54%)
- of these, 13 did not (46%)

10 betas increased 20 percent or more.
- of these, 2 began put trading during the period (20%)
- of these, 8 did not (80%)

35 betas had changes between ± 20 percent.
- of these, 9 began put trading during the period
- of these, 26 did not

26 Underlying Stocks had put trading begin during the period.
- 15 had betas that declined 20 percent or more (58%)
- 2 had betas that increased 20 percent or more (7%)
- 9 had betas change between ± 20 percent (35%)

on abnormal return estimates is the very short time frame over which the abnormal returns are estimated in this study. A typical range of market return for a single trading day is small relative to a monthly period. Therefore, even relatively large changes in beta or errors in estimating beta will have a very minor impact on estimated abnormal returns.

Daily Abnormal Return Results

The average abnormal return performance of the underlying stocks on a daily basis during the two weeks surrounding the expiration date is shown in Tables 6-8. Table 6 contains the average residuals (AR_k's) or abnormal returns calculated for each of the 32 expiration periods during the ten day residual analysis period. The Friday of the expiration week is designated day zero. The t-statistic is shown in parentheses. Table 7 contains the cumulative average residuals presented in a format similar to Table 6. Table 8 presents an aggregate average of all 32 expiration periods by daily average residuals and cumulative average residuals (CAR) over the ten day residual analysis period.

The results presented in these three tables support the hypothesis that options negatively affect underlying stock prices during the expiration week. Of the 32 expiration periods studied, 27 had CAR's that were negative on the

Table 6. Average Residual Returns for the 10 Days Surrounding the Option Expiration for 32 Event Periods

Expiration Period	Time-trading Days Relative to the Expiration Friday (Day 0)									
	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
Jan. 1978	.0013 (.901)	.0041 (3.47)**	.0014 (1.15)	.0003 (.243)	-.0015 (-1.01)	.0009 (.632)	.0009 (.791)	-.0006 (-.504)	-.0011 (-.840)	.0004 (.287)
Feb. 1978	-.0020 (-1.86)**	.0014 (.903)	-.0017 (-1.26)	.0009 (.763)	-.0001 (-.527)	-.0027 (-1.58)*	.0012 (.558)	-.0017 (-1.46)*	.0056 (2.21)**	.0034 (1.85)**
Apr. 1978	-.0017 (-.882)	.0005 (.317)	-.0004 (-.308)	-.0011 (-.740)	-.0030 (-2.91)**	.0027 (1.77)**	-.0017 (-.847)	-.0008 (-.550)	.0005 (.401)	-.0018 (-1.05)
May 1978	-.0022 (-.939)	-.0004 (-.225)	-.0040 (-1.79)**	-.0034 (-1.78)**	-.0031 (-1.62)*	.0005 (.197)	.0035 (2.00)**	.0004 (.226)	-.0007 (-.472)	.0005 (.428)
July 1978	.0002 (.157)	-.0001 (-.129)	-.0007 (-.557)	-.0025 (-1.42)*	-.0032 (-2.46)**	.0002 (.133)	.0032 (1.89)**	.0003 (.173)	.0040 (2.33)**	.0004 (.308)
Aug. 1978	-.0010 (-.665)	-.0016 (-.662)	-.0019 (-1.23)	-.0013 (-.668)	-.0021 (-1.36)*	-.0040 (-2.48)**	.0004 (.262)	.0007 (.421)	.0011 (.598)	.0034 (1.38)*
Oct. 1978	.0021 (1.93)**	-.0021 (-1.39)*	-.0005 (-.351)	-.0004 (-.327)	-.0008 (-.386)	-.0020 (-1.13)	.0019 (1.23)	-.0007 (-.452)	-.0022 (-1.40)*	-.0018 (-.788)
Nov. 1978	-.0016 (-.729)	-.0047 (-2.41)**	.0007 (.485)	-.0032 (-1.92)**	-.0017 (-.840)	.0000 (.001)	.0002 (.154)	.0025 (1.28)	.0048 (2.16)**	.0023 (1.41)*
Jan. 1979	-.0001 (-.053)	-.0012 (-.906)	-.0019 (-1.43)*	.0016 (.942)	-.0026 (-1.31)*	.0004 (.228)	-.0015 (-.804)	.0031 (2.17)**	-.0004 (-.266)	.0002 (.129)
Feb. 1979	-.0031 (-1.24)	-.0015 (-1.25)	.0000 (.011)	-.0002 (-.123)	-.0039 (-1.86)**	-.0023 (-.992)	.0107 (2.75)**	-.0017 (-.771)	.0009 (.503)	.0009 (.572)
Apr. 1979	-.0016 (-1.41)*	-.0031 (-2.11)**	.0024 (1.84)**	-.0014 (-1.21)	.0001 (.078)	-.0006 (-.485)	-.0030 (-1.71)**	-.0000 (-.032)	.0007 (.689)	-.0003 (-.216)
May 1979	.0013 (.455)	.0018 (1.35)*	-.0008 (-.407)	-.0002 (-.067)	-.0010 (-.460)	.0024 (.794)	.0027 (1.14)	.0024 (1.08)	-.0038 (-1.37)*	-.0016 (-.714)
July 1979	-.0014 (-.843)	-.0021 (-1.45)*	-.0002 (-.101)	.0002 (.159)	-.0021 (-1.70)**	-.0015 (-1.19)	.0005 (.444)	-.0007 (-.443)	.0004 (.358)	-.0006 (-.459)
Aug. 1979	-.0012 (-.548)	-.0025 (-1.68)**	.0011 (.615)	-.0019 (-1.04)	-.0001 (-.046)	-.0021 (-1.45)*	-.0006 (-.326)	.0013 (.724)	-.0014 (-.871)	.0002 (.099)
Oct. 1979	-.0018 (-1.09)	-.0002 (-.127)	.0007 (.655)	-.0048 (-3.29)**	.0008 (.508)	.0011 (.511)	.0034 (2.03)**	-.0001 (-.064)	.0002 (.242)	-.0010 (-.581)
Nov. 1979	-.0005 (-.294)	-.0013 (-.756)	.0010 (.640)	-.0024 (-1.31)*	.0012 (.620)	.0006 (.275)	.0038 (1.69)**	.0057 (2.53)**	.0054 (2.21)**	-.0003 (-.109)

Table 6.--Continued

Expiration Period	Time-trading Days Relative to the Expiration Friday (Day 0)									
	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
Jan. 1980	.0002	-.0005	.0014	.0010	-.0039	-.0010	-.0025	.0051	-.0023	-.0004
	(.082)	(-.214)	(.558)	(.442)	(-1.71)**	(-.409)	(-.925)	(2.38)**	(-1.22)	(-.193)
Feb. 1980	-.0029	-.0021	-.0049	.0017	.0049	.0002	-.0043	-.0012	.0008	.0016
	(-.933)	(-.796)	(-2.25)**	(.579)	(2.45)**	(.075)	(-1.74)**	(-.478)	(.387)	(.887)
Apr. 1980	-.0026	-.0026	-.0007	-.0000	-.0046	.0024	.0019	-.0002	.0056	-.0029
	(-1.35)*	(-1.50)*	(-.248)	(-.011)	(-2.45)**	(1.32)*	(.758)	(-.118)	(2.34)**	(-1.51)*
May 1980	-.0009	-.0012	.0039	.0010	-.0023	-.0018	.0014	.0019	.0012	.0030
	(-.499)	(-.631)	(1.62)*	(.452)	(-1.25)	(-.896)	(.653)	(.867)	(.539)	(1.24)
July 1980	-.0033	.0007	.0002	-.0031	-.0001	-.0020	.0021	-.0022	-.0011	.0010
	(-1.88)**	(.427)	(.147)	(-1.67)*	(-.084)	(-1.12)	(1.08)	(-1.22)	(-.745)	(.573)
Aug. 1980	-.0013	-.0017	.0017	-.0067	-.0047	.0040	.0030	-.0005	.0012	.0047
	(-.753)	(-1.04)	(.978)	(-3.87)**	(-2.52)**	(2.18)**	(1.33)*	(-.217)	(.535)	(1.81)**
Oct. 1980	-.0025	.0012	-.0036	-.0044	-.0009	-.0049	-.0027	.0024	-.0007	.0009
	(-1.45)*	(.744)	(-1.98)**	(-2.32)**	(-.567)	(-2.48)**	(-1.36)*	(1.28)	(-.395)	(.512)
Nov. 1980	-.0007	-.0023	-.0016	-.0017	.0004	.0030	.0013	-.0037	-.0009	.0058
	(-.297)	(-1.08)	(-.687)	(-.752)	(.148)	(1.13)	(.437)	(-1.22)	(-.348)	(3.09)**
Jan. 1981	-.0037	-.0024	-.0021	-.0063	-.0027	.0004	.0006	-.0002	.0023	-.0012
	(-2.00)**	(-1.67)*	(-1.34)*	(-3.17)**	(-1.77)**	(.269)	(.362)	(-.103)	(.892)	(-.609)
Feb. 1981	.0021	-.0022	-.0015	-.0045	-.0019	-.0020	-.0005	-.0024	.0025	.0059
	(1.21)	(-1.37)*	(-.806)	(-1.99)**	(-1.03)	(-1.10)	(-.157)	(-.807)	(1.18)	(1.90)**
Apr. 1981	.0036	-.0018	-.0013	.0027	-.0001	.0012	.0025	.0020	-.0000	-.0008
	(1.77)**	(-1.01)	(-.717)	(1.27)	(-.052)	(.490)	(1.42)*	(.728)	(-.026)	(-.498)
May 1981	.0023	-.0009	.0004	-.0009	.0031	.0020	-.0027	.0033	.0004	.0060
	(1.60)*	(-.584)	(.216)	(-.585)	(1.68)**	(1.04)	(-1.73)**	(1.79)**	(.265)	(2.99)**
July 1981	-.0021	-.0019	-.0005	-.0003	-.0022	-.0062	-.0014	.0037	-.0004	.0039
	(-1.28)	(-.800)	(-.195)	(-.157)	(-.810)	(-3.12)**	(-.608)	(2.17)**	(-.225)	(1.97)**
Aug. 1981	-.0019	-.0019	.0005	-.0013	-.0011	.0018	.0013	.0000	.0003	-.0035
	(-1.08)	(-1.17)	(.292)	(-.894)	(-.672)	(.912)	(.554)	(.015)	(.179)	(-1.21)
Oct. 1981	-.0000	.0013	-.0038	-.0002	.0005	-.0008	.0004	-.0026	.0006	.0003
	(-.004)	(.399)	(-1.78)**	(-.072)	(.277)	(-.309)	(.211)	(-1.50)*	(.284)	(.160)
Nov. 1981	-.0017	.0026	.0-04	-.0008	-.0031	-.0022	.0007	-.0011	-.0002	.0017
	(-1.03)	(1.39)*	(.190)	(-.467)	(-1.89)**	(-.929)	(.349)	(-.512)	(-.077)	(.743)

(t-statistic in parentheses).

*Significant at 10% level, one-tail test.

**Significant at 5% level, one-tail test.

Table 7. Cumulative Average Residual Returns for the 10 Days Surrounding the Option Expiration for 32 Event Periods

Expiration Period	Time-trading Days Relative to the Expiration Friday (Day 0)									
	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
Jan. 1978	.0013	.0054	.0068	.0071	.0056	.0065	.0074	.0068	.0057	.0061
Feb. 1978	-.0020	-.0006	-.0023	-.0014	-.0015	-.0042	-.0030	-.0047	.0009	.0043
Apr. 1978	-.0017	-.0012	-.0016	-.0027	-.0057	-.0030	-.0047	-.0055	-.0050	-.0068
May 1978	-.0022	-.0026	-.0066	-.0100	-.0131	-.0126	-.0090	-.0086	-.0093	-.0088
July 1978	.0002	.0001	-.0006	-.0031	-.0063	-.0061	-.0029	-.0026	.0014	.0018
Aug. 1978	-.0010	-.0026	-.0045	-.0058	-.0079	-.0119	-.0115	-.0108	-.0097	-.0063
Oct. 1978	.0021	.0000	-.0005	-.0009	-.0017	-.0037	-.0018	-.0025	-.0047	-.0065
Nov. 1978	-.0016	-.0063	-.0056	-.0088	-.0105	-.0105	-.0103	-.0078	-.0030	-.0007
Jan. 1979	-.0001	-.0013	-.0032	-.0016	-.0042	-.0038	-.0053	-.0022	-.0026	-.0024
Feb. 1979	-.0031	-.0046	-.0046	-.0048	-.0087	-.0110	-.0003	-.0020	-.0011	-.0002
Apr. 1979	-.0016	-.0047	-.0023	-.0037	-.0036	-.0042	-.0072	-.0072	-.0065	-.0068
May 1979	.0013	.0031	.0023	.0021	.0011	.0035	.0062	.0086	.0048	.0032
July 1979	-.0014	-.0035	-.0037	-.0035	-.0056	-.0071	-.0066	-.0073	-.0069	-.0075
Aug. 1979	-.0012	-.0037	-.0026	-.0045	-.0046	-.0067	-.0073	-.0060	-.0074	-.0072
Oct. 1979	-.0018	-.0020	-.0013	-.0061	-.0053	-.0042	-.0008	-.0009	-.0007	-.0017
Nov. 1979	-.0005	-.0018	-.0008	-.0032	-.0020	-.0014	.0024	.0081	.0135	.0132
Jan. 1980	.0002	-.0003	.0011	.0021	-.0018	-.0028	-.0053	-.0002	-.0025	-.0029
Feb. 1980	-.0029	-.0050	-.0099	-.0082	-.0033	-.0031	-.0074	-.0086	-.0078	-.0062
Apr. 1980	-.0026	-.0052	-.0059	-.0059	-.0105	-.0081	-.0062	-.0064	-.0008	-.0037
May 1980	-.0009	-.0021	.0018	.0028	.0005	-.0013	.0001	.0020	.0032	.0062
July 1980	-.0033	-.0026	-.0024	-.0055	-.0056	-.0076	-.0055	-.0077	-.0088	-.0078
Aug. 1980	-.0013	-.0030	-.0013	-.0080	-.0127	-.0087	-.0057	-.0062	-.0050	-.0003
Oct. 1980	-.0025	-.0013	-.0049	-.0093	-.0102	-.0151	-.0178	-.0154	-.0161	-.0152
Nov. 1980	-.0007	-.0030	-.0046	-.0063	-.0059	-.0029	-.0016	-.0053	-.0062	-.0004

Table 7.--Continued

Expiration Period	Time-trading Days Relative to the Expiration Friday (Day 0)									
	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
Jan. 1981	-.0037	-.0061	-.0082	-.0145	-.0172	-.0168	-.0162	-.0164	-.0141	-.0153
Feb. 1981	.0021	-.0001	-.0016	-.0061	-.0080	-.0100	-.0105	-.0129	-.0104	-.0045
Apr. 1981	.0036	.0018	.0005	.0032	.0031	.0043	.0068	.0088	.0088	.0080
May 1981	.0023	.0014	.0018	.0009	.0040	.0060	.0033	.0066	.0070	.0130
July 1981	-.0021	-.0040	-.0045	-.0048	-.0070	-.0132	-.0146	-.0109	-.0113	-.0074
Aug. 1981	-.0019	-.0038	-.0033	-.0046	-.0057	-.0039	-.0026	-.0026	-.0023	-.0058
Oct. 1981	.0000	.0013	-.0025	-.0027	-.0022	-.0030	-.0026	-.0052	-.0046	-.0043
Nov. 1981	-.0017	.0009	.0013	.0005	-.0026	-.0048	-.0041	-.0052	-.0054	-.0037

Table 8. Aggregate Average Residuals and Cumulative Average Residuals for the 10 Days Surrounding the Option Expiration

Day	Aggregate Aver. Residual	t Statistic	-4 to +5 CAR	% of Ave. Residuals that are Negative
-4 Monday	-.000765	-1.059	-.000765	75%
-3 Tuesday	-.000897	-1.337	-.001662	75%
-2 Wednesday	-.000509	-0.728	-.002171	56%
-1 Thursday	-.001363	-2.013**	-.003534	75%
0 Friday	-.001306	-1.867*	-.004840	78%
+1 Monday	-.000384	-0.481	-.005224	47%
+2 Tuesday	.000838	1.425	-.004386	34%
+3 Wednesday	.000450	0.799	-.003936	50%
+4 Thursday	.000728	1.273	-.003208	41%
+5 Friday	.000947	1.562	-.002261	38%

*Significant at the .10 level.

**Significant at the .05 level.

Friday prior to expiration. Looking at the daily average residuals, Table 6 shows that 25 of the 32 (78%) Friday residuals were negative and 14 were significantly negative. On Thursday, 24 of the 32 (75%) residuals were negative and ten were significantly negative. On Monday through Wednesday prior to expiration, the number and significance of negative residuals declined. However, on each day the number of negative average residuals exceeded the positive ones and all three days have aggregate negative residuals, as seen in Table 8.

These results, therefore, support the additional hypothesis that the greatest negative price effect on the underlying stocks occurs on the Thursday and Friday prior to expiration. This result is clearly evident in Table 8 where the residuals are negative for each day of the expiration week and are significantly negative on Thursday and Friday. Thus, it appears that options trading creates downward pressure on the underlying stocks during the expiration week, with the significant pressure occurring on Thursday and Friday.

The results also support the hypothesis that positive abnormal returns should occur in the subsequent week when the downward expiration pressures disappear and equilibrium prices are restored. The downward pressure is reversed beginning on Tuesday of the subsequent week, although none of the positive residuals on Tuesday through

Friday are statistically significant. Nonetheless, the cumulative average residuals in Table 8 indicate that much of the negative price effect in the expiration week is recouped in the week following expiration.

The average residual price change in the expiration week was approximately -.52%. In line with the lesser significant residuals in the week following expiration, the average residual price change in that week was approximately .24%. The daily abnormal return results reported in this chapter are generally in agreement with the results shown in a paper by Officer and Trennepohl (1981). Their study was undertaken concurrent with this dissertation and they use a methodology different from the one in this paper to arrive at their return results.

A graphic presentation of the Table 8 results is presented in Figure 1. The CAR's are plotted over the 10 day residual analysis period. Day zero is the Friday of the expiration week. Again, the downward bias of the expiration week is seen followed by a reversal in the subsequent week.

Several representative plots of the cumulative average residuals for the individual expiration months are shown in Appendix B. The general pattern is similar to Figure 1, with the CAR declining in the expiration week and rising in the subsequent week. The CAR plot in Figure 1 is

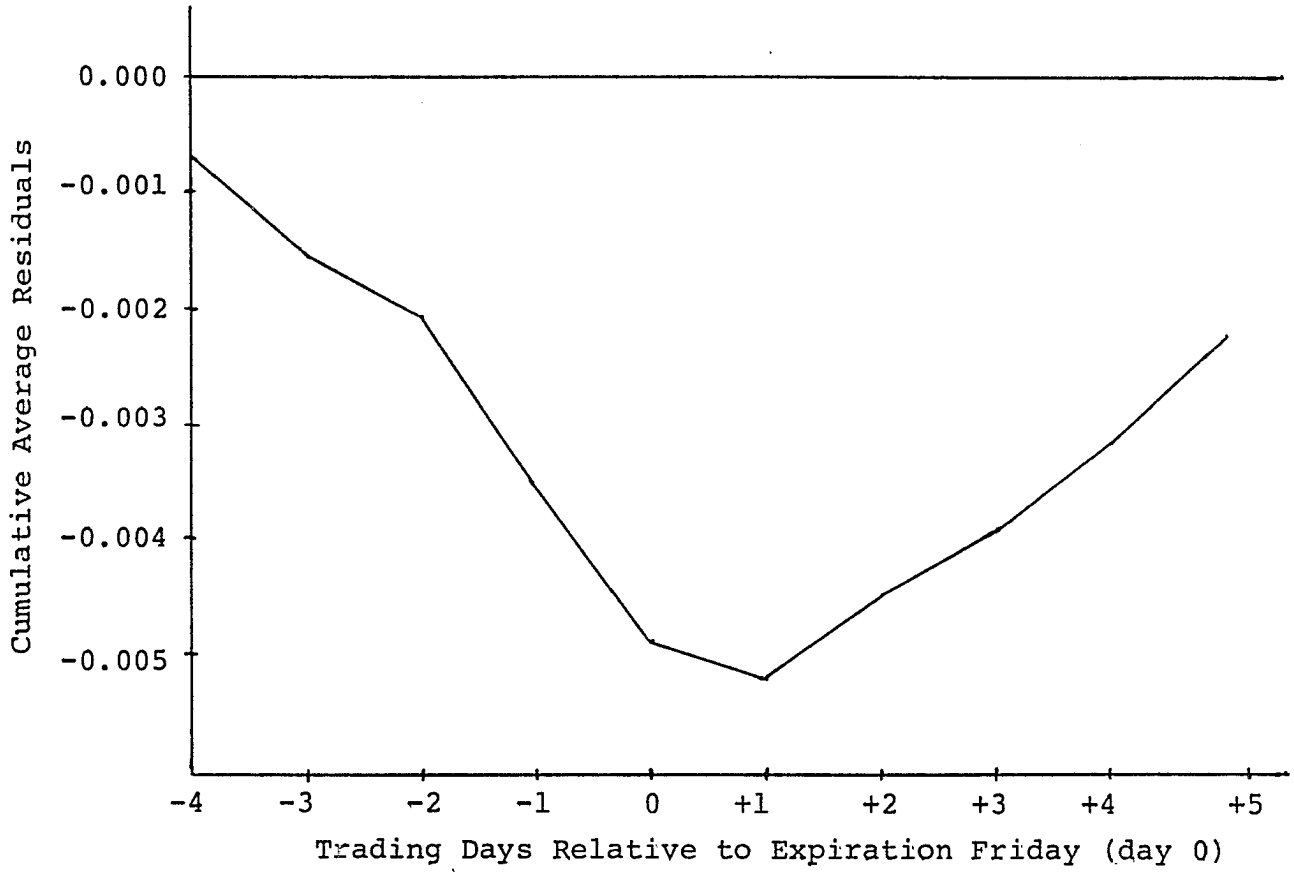


Figure 1. Cumulative Average Residuals for 10 Days Surrounding Expiration -- An aggregation of the 32 expiration periods.

smoother than the plots in Appendix B as it is an aggregate of the 32 monthly CAR plots.

Cross-Sectional Regression Results

The results of the stage 1 tests show that, on average, negative abnormal returns occurred during the five days prior to the option expiration date. In the second phase of the tests, cross-sectional regressions are used to determine whether the size and sign of the stock returns during the expiration week are related to stock and option volume during the expiration week, to whether puts were traded and to whether the options were dually listed. The predicted direction of the relationship between the dependent variable, stock returns, and the several independent variables was discussed in Chapter IV.

The following regression was used:

$$CAR_{jt} = a_0 + a_1 OV_{jt} + a_2 SV_{jt} + a_3 DL_{jt} + a_4 PT_{jt}$$

where: CAR_{jt} = cumulative average residual for the 5 days prior to expiration for stock j in test period t (t = 1-11 and the sample includes all stocks used in the stage 1 tests--73 cycle 1 and 65 cycle 2 firms)

OV_{jt} = relative option volume for firm j in test period t.

SV_{jt} = relative stock volume for firm j in test period t.

DL_{jt} = dummy variable--1 if firm j in test period t is dually listed, 0 if not dually listed.

PT_{jt} = dummy variable--1 if firm j in test period t has puts traded, 0 if no puts traded.

Table 9 presents the means and standard deviations of each dependent and independent variable for each of the 11 cross-sectional test runs.

The results of the regression runs are shown in Table 10. An examination of the table reveals that the estimated coefficients have the predicted sign in all but two cases (January 1978--OV and January 1981--PT). OV is negative in 10 of 11 expiration periods and significantly negative in 6 of those periods. This result supports Hypothesis H_1. The negative sign indicates that the greater the increase in option volume during the expiration week, the more negative is the CAR for the week.

SV appears to be an even stronger variable in explaining the size and sign of the CAR's during the expiration week. It is negative in all 11 expiration periods and significantly negative in 8 of them. This result supports Hypothesis H_2. The negative sign indicates that the greater the increase in underlying stock volume during the expiration week, the more negative is the CAR for

Table 9. Means and Standard Deviations of the Dependent and Independent Variables for Each Expiration Period Tested

	CAR		OV		SV		DL		PT	
	Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ
Jan. 1978	17.47	125.89	1.24	.481	1.19	.393	.158	.371	--	--
Feb. 1978	-33.55	134.72	1.48	.512	1.25	.499	.072	.242	--	--
July 1978	-79.35	138.02	2.14	.973	1.32	.525	.158	.371	--	--
May 1979	-28.69	120.80	1.54	.449	1.20	.341	.094	.296	--	--
Oct. 1979	-55.91	143.26	1.41	.539	1.21	.483	.204	.413	--	--
Feb. 1980	-28.83	129.25	1.64	.573	1.28	.514	.058	.224	--	--
Aug. 1980	-70.79	135.82	1.54	.487	1.24	.479	.058	.224	.314	.571
Oct. 1980	-45.21	152.53	1.49	.550	1.22	.507	.256	.442	.436	.502
Jan. 1981	-84.47	142.66	1.68	.613	1.27	.552	.250	.439	.541	.489
July 1981	-12.38	137.55	1.52	.450	1.16	.426	.250	.439	.657	.474
Nov. 1981	-41.69	127.18	1.33	.428	1.19	.449	.074	.244	.783	.451
Average	-42.13		1.55		1.23		.148		.609	

Table 10. Coefficient Estimates from Cross-Sectional Regressions

Coefficient (Predicted Sign)	Constant	OV(-)	SV(-)	DL(-)	PT(+)	Uncorrected R^2	Corrected R^2	F Statistic (significance)
Expiration Period								
Jan. 1978	.0213 (4.39)	.0015 (.630)	-.0109 (-1.43)	-.0103 (-2.84)**	-- --	.513	.476	11.47 (.001)
Feb. 1978	.0228 (3.77)	-.0048 (-1.85)*	-.0088 (-2.52)**	-.0025 (-.511)	-- --	.547	.523	12.38 (.001)
July 1978	.0204 (8.10)	-.0033 (-3.09)**	-.0147 (-3.58)**	-.0113 (-4.57)**	-- --	.672	.659	29.73 (.001)
May 1979	.0299 (4.37)	-.0081 (-1.91)*	-.0167 (-2.95)**	-.0027 (-.473	-- --	.491	.436	9.00 (.001)
Oct. 1979	.0198 (2.65)	-.0048 (-1.59)	-.0129 (-1.43)	-.0133 (-2.37)**	-- --	.518	.457	10.72 (.001)
Feb. 1980	.0236 (5.32)	-.0105 (-2.28)**	-.0098 (-1.82)*	-.0023 (-.498)	-- --	.502	.452	9.57 (.001)
Aug. 1980	.0250 (7.03)	-.0148 (-3.17)**	-.0075 (-2.29)**	-.0028 (-.552)	.0042 (.882)	.603	.557	18.89 (.001)
Oct. 1980	.0209 (2.91)	-.0064 (-1.47)	-.0113 (-2.49)**	-.0190 (-2.43)**	.0063 (1.24)	.404	.334	5.76 (.01)
Jan. 1981	.0196 (2.42)	-.0128 (-2.82)**	-.0152 (-1.88)*	-.0157 (-2.14)**	-.0012 (-.692)	.483	.446	8.14 (.001)
July 1981	.0193 (2.78)	-.0054 (-1.19)	-.0146 (-3.07)**	-.0075 (-1.70)*	.0097 (2.41)**	.441	.377	4.91 (.01)
Nov. 1981	.0203 (2.24)	-.0076 (-1.24)	-.0082 (-1.11)	-.0024 (-.476)	.0053 (2.09)**	.463	.427	6.37 (.01)

(t-statistic in parentheses)

*Significant at 10% level, two-tail test.

**Significant at 5% level, two-tail test.

the week. Thus it appears that position unwinding, arbitrage activity and even manipulation that are evidenced by and exist to a greater extent in a high volume environment are depressing underlying stock prices in the days prior to expiration.

DL is negative (as predicted) in all 11 expiration periods and significantly so in 6 of them. This result supports Hypothesis H_4. The negative sign indicates that the presence of dually listed options results in more negative CAR's in the underlying stocks. Apparently, the increased arbitrage activity that dual listing facilitates has a depressing effect on underlying stock prices during the expiration week.

The final coefficient, PT, is positive (as predicted) in 4 of 5 expiration periods where put trading is relevant. It is significantly positive in 2 of these periods. The positive sign indicates that the presence of puts reduces the negative effect of the call options, which supports Hypothesis H_3.

The Coefficient of Correlation (R^2) ranges from .404 to .632 for the 11 expiration periods tested. The F statistic was significant at the .01 level in 2 cases and at the .001 level in the other 9 cases. Given that cross-sectional data are used in the tests, the R-squares appear to be "high" enough to draw fairly strong conclusions regarding the variation in the dependent variable explained

by variation in the independent variables. The estimated relationship fits the data fairly well. The robustness of the regressions is further corroborated by the F statistic. The significant F-statistics shown in Table 10 imply that the explained variation of the CAR's is significantly high relative to the unexplained variation. Thus, it appears that the independent variables, as a set, do strongly influence the level and sign of the CAR's. Therefore, the robustness of the regressions provides fairly strong support for the hypotheses suggested in this study.

Additional Test of Puts Trading Variable

An additional test was run in an attempt to lend further support to the hypothesis that the presence of puts trading should reduce or negate to some extent the downward pressure on underlying stock prices in the week prior to expiration. The results of the test confirm the earlier findings of the cross-sectional regressions regarding puts trading.

The test consists of dividing the 73 and 65 firm samples into two sub-samples. One sub-sample was made up of those stocks in the complete sample that had put options traded. The other sub-sample consisted of all non-put stocks. Daily average residuals and CAR's were calculated, as before, on each of the sub-samples beginning with the July 1980 expiration period. The hypothesis is that the

non-puts group should show larger negative CAR's than the puts only group in the expiration week. The results of the test are presented in Tables 11 and 12 and Figure 2.

An examination of Table 11 reveals that in 11 out of the 12 expiration periods tested the non-put group of stocks had CAR's that were more negative than the puts only group. In 5 out of the 12 expiration periods the puts only group of stocks actually had positive CAR's while the non-put groups had negative CAR's in all 12 periods. A mean difference test was run to test the null hypothesis that the mean of the non-put CAR's equals the mean of the puts-only CAR's. The null hypothesis is rejected at the .01 level and therefore substantiates the claim that stocks with puts traded are significantly less negatively affected than non-put underlying stocks.

Table 12 and Figure 2 present the aggregate average residuals and CAR's of the non-puts, puts only and complete sample over the 5 days prior to expiration. Again, it can be seen that stocks with puts traded experienced a much smaller negative price reaction in the expiration week than did non-put stocks. It is also shown that there is a significant difference between the puts-only and non-puts groups for four of the five days during the expiration week. The average residual price change for the non-put stocks for the expiration week was approximately -1.30 percent.

Table 11. Average Residuals and CAR's for the Complete Sample, Puts-Only and Non-Puts Only Groups Over the 5 Days Prior to Expiration Beginning with the July 1980 Expiration Period

Day	Complete Sample		Puts-Only		Non-Puts Only	
July 1980:						
-4 Monday	-.0033	(1.88)	.0024	(.603)	-.0036	(-1.69)
-3 Tuesday	.0007	(.427)	-.0034	(-1.19)	.0016	(.759)
-2 Wednesday	.0002	(.147)	-.0012	(-.562)	.0002	(.113)
-1 Thursday	-.0031	(-1.67)	.0002	(.053)	-.0044	(-2.00)
0 Friday	-.0001	(-.084)	-.0041	(-1.55)	.0018	(.927)
CAR (-4, 0)	-.0056		-.0061		-.0044	
Aug. 1980:						
-4 Monday	-.0013	(-.753)	-.0018	(-.486)	-.0029	(-1.55)
-3 Tuesday	-.0017	(-1.04)	-.0054	(-1.35)	-.0023	(-1.06)
-2 Wednesday	.0017	(.978)	.0039	(1.19)	.0013	(.762)
-1 Thursday	-.0067	(-3.87)	-.0057	(-1.95)	-.0063	(-3.06)
0 Friday	-.0047	(-2.52)	.0000	(.004)	-.0062	(-2.88)
CAR (-4, 0)	-.0127		-.0090		-.0164	
Oct. 1980:						
-4 Monday	-.0025	(-1.45)	.0008	(.308)	-.0063	(-3.22)
-3 Tuesday	-.0012	(.744)	-.0018	(-.915)	.0021	(.923)
-2 Wednesday	-.0036	(-1.98)	.0017	(.539)	-.0059	(-2.65)
-1 Thursday	-.0044	(-2.32)	-.0075	(-2.34)	-.0026	(-1.09)
0 Friday	-.0009	(-.567)	-.0003	(-.116)	-.0005	(.247)
CAR (-4, 0)	-.0102		-.0071		-.0122	
Nov. 1980:						
-4 Monday	-.0007	(-.297)	.0059	(1.32)	-.0055	(-2.72)
-3 Tuesday	-.0023	(-1.08)	-.0011	(-.365)	-.0031	(-1.10)
-2 Wednesday	-.0016	(-.687)	-.0009	(-.283)	-.0017	(-.538)
-1 Thursday	-.0017	(-.752)	-.0039	(-1.49)	.0009	(.294)
0 Friday	.0004	(.148)	.0065	(1.43)	-.0045	(-1.47)
CAR (-4, 0)	-.0059		+.0065		-.0139	

Table 11.--Continued Average Residuals and CAR's for the Complete Sample, Puts-Only and Non-Puts Only Groups Over the 5 Days Prior to Expiration Beginning with the July 1980 Expiration Period

Day	Complete Sample		Puts-Only		Non-Puts Only	
Jan. 1981:						
-4 Monday	-.0037	(-2.00)	-.0037	(-1.86)	-.0031	(-.885)
-3 Tuesday	-.0024	(-1.67)	-.0013	(-.698)	-.0043	(-1.02)
-2 Wednesday	-.0021	(-1.34)	-.0014	(-.794)	-.0024	(-.745)
-1 Thursday	-.0063	(-3.17)	-.0060	(-2.36)	-.0042	(-1.41)
0 Friday	-.0027	(-1.77)	-.0011	(-.642)	-.0040	(-1.28)
CAR (-4, 0)	-.0172		-.0135		-.0180	
Feb. 1981:						
-4 Monday	.0021	(1.21)	.0028	(.581)	.0003	(.124)
-3 Tuesday	-.0022	(-1.37)	-.0005	(-.238)	-.0046	(-2.33)
-2 Wednesday	-.0015	(-.806)	-.0012	(-.392)	-.0023	(-1.24)
-1 Thursday	-.0045	(-1.99)	-.0023	(-.499)	-.0067	(-2.89)
0 Friday	-.0019	(-1.03)	-.0011	(-.361)	-.0029	(-1.58)
CAR (-4, 0)	-.0080		-.0023		-.0162	
Apr. 1981:						
-4 Monday	.0035	(1.77)	.0038	(1.51)	.0036	(.774)
-3 Tuesday	-.0018	(-1.01)	-.0027	(-1.23)	.0016	(.487)
-2 Wednesday	-.0013	(-.717)	-.0007	(-.396)	-.0046	(-.993)
-1 Thursday	.0027	(1.27)	.0037	(1.52)	-.0023	(-.465)
0 Friday	-.0001	(-.052)	-.0005	(-.196)	-.0010	(-.259)
CAR (-4, 0)	+.0031		+.0036		-.0027	
May 1981:						
-4 Monday	.0023	(1.60)	.0031	(.638)	.0019	(.792)
-3 Tuesday	-.0009	(-.584)	.0005	(.257)	-.0033	(-1.62)
-2 Wednesday	.0004	(.216)	.0008	(.298)	-.0007	(-.339)
-1 Thursday	-.0009	(-.585)	-.0014	(-.413)	-.0006	(-.301)
0 Friday	.0031	(1.68)	.0045	(1.18)	-.0012	(-.497)
CAR (-4, 0)	+.0040		+.0075		-.0039	

Table 11.--Continued Average Residuals and CAR's for the Complete Sample, Puts-Only and Non-Puts Only Groups Over the 5 Days Prior to Expiration Beginning with the July 1980 Expiration Period

Day	Complete Sample		Puts-Only		Non-Puts Only	
July 1981:						
-4 Monday	-.0021	(-1.28)	-.0028	(-1.54)	-.0015	(-.346)
-3 Tuesday	-.0019	(-.800)	.0006	(.197)	-.0103	(-1.96)
-2 Wednesday	-.0005	(-.195)	.0014	(.439)	-.0067	(-1.63)
-1 Thursday	-.0003	(-.157)	.0013	(.563)	-.0036	(-1.01)
0 Friday	-.0022	(-.810)	-.0029	(-1.24)	.0063	(1.34)
CAR (-4, 0)	-.0070		-.0024		-.0158	
Aug. 1981:						
-4 Monday	-.0019	(-1.08)	-.0012	(-.447)	-.0027	(-1.42)
-3 Tuesday	-.0019	(-1.17)	-.0008	(-.271)	-.0034	(-1.69)
-2 Wednesday	.0005	(.292)	.0019	(.638)	-.0005	(-.288)
-1 Thursday	-.0013	(-.894)	-.0018	(-.737)	-.0016	(-.739)
0 Friday	-.0011	(-.672)	.0007	(.308)	-.0031	(-1.48)
CAR (-4, 0)	-.0057		-.0012		-.0113	
Oct. 1981:						
-4 Monday	-.0000	(-.004)	.0005	(.238)	.0016	(.498)
-3 Tuesday	.0013	(.399)	.0041	(.961)	-.0025	(-.845)
-2 Wednesday	-.0038	(-1.78)	-.0032	(-1.10)	-.0076	(-1.68)
-1 Thursday	-.0002	(-.073)	.0029	(1.20)	-.0080	(-2.09)
0 Friday	.0005	(.277)	.0033	(2.12)	-.0130	(-2.66)
CAR (-4, 0)	-.0022		+.0076		-.0295	
Nov. 1981:						
-4 Monday	-.0017	(-1.03)	-.0003	(-.187)	-.0037	(-1.82)
-3 Tuesday	.0026	(1.39)	.0039	(1.27)	.0009	(.362)
-2 Wednesday	.0004	(.190)	.0018	(.647)	-.0015	(-.791)
-1 Thursday	-.0008	(-.467)	.0007	(.342)	-.0022	(-1.13)
0 Friday	-.0031	(-1.89)	-.0024	(-.638)	-.0038	(-1.94)
CAR (-4, 0)	-.0026		+.0037		-.0103	

Table 12. Aggregate Average Residuals and CAR's for the Complete Sample, Puts-Only and Non-Puts Groups Over the 5 Days Prior to Expiration

	Complete Sample	CAR	Puts-Only	CAR	Non-Puts	CAR
-4 Monday	-.000682	-.000682	+.000792	+.000792	-.001825***	-.001825
-3 Tuesday	-.000776	-.001459	-.000658	+.000134	-.002300	-.004125
-2 Wednesday	-.000933	-.002392	+.000242	+.000376	-.002700***	-.006825
-1 Thursday	-.002292	-.004684	-.001650	-.001274	-.003467*	-.010292
0 Friday	-.001067	-.005751	+.000217	-.001057	-.002592**	-.012884

*Significantly different from Puts-Only Group at 20% level.

**Significantly different from Puts-Only Group at 10% level.

***Significantly different from Puts-Only Group at 5% level.

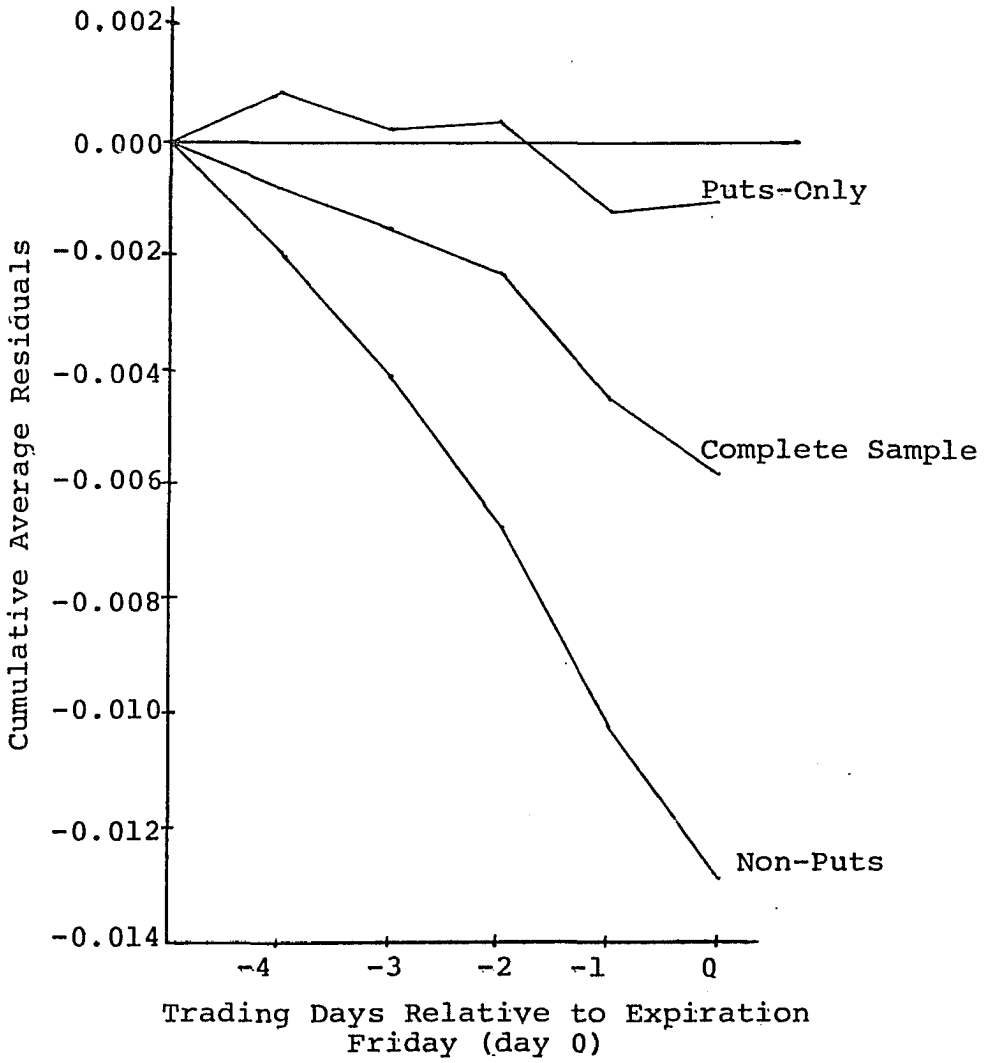


Figure 2. Aggregate CAR's for the Complete Sample, Puts-Only and Non-Puts Groups Over the 5 Days Prior to Expiration

While, the average residual price change for the puts-only stocks for the same period was only about -.10 percent.

Therefore, the hypothesis that puts offset the negative price effects of calls is further substantiated by these findings. In addition, as the number of stocks with puts traded increased beginning in mid 1980 and as puts volume expanded, the offsetting effect should be more pronounced as time passes. This appears to be somewhat substantiated as the difference in CAR's between the two groups gradually widens over the one and a half year period covering 12 expiration periods beginning in July 1980. Table 13 presents these results.

Table 13. Comparison of Differences Between the CAR's of Non-Puts Versus Puts-Only Groups

Expiration Period	Difference Between CAR's
July 1980	(.0017)
August 1980	.0074
October 1980	.0051
November 1980	.0204
January 1981	.0045
February 1981	.0139
April 1981	.0063
May 1981	.0114
July 1981	.0134
August 1981	.0101
October 1981	.0371
November 1981	.0140

CHAPTER VII

CONCLUSION

The intent of this chapter is to summarize the content of the dissertation, present some conclusions based on the results, review the implications of the study and provide suggestions for future research.

Content of the Dissertation

The motivation for this study came partially out of the conflicting evidence in the literature regarding the effect of options trading on the underlying stocks around the expiration date. It was further motivated by a perceived need to expand on a paper by Klemkosky (1978). Finally, motivation came from curiosity about not just if options trading affected underlying stocks, but how this effect was caused. Could a model be developed that partially explained the observed abnormal stock returns? Of course, a key motivation which underlies all the above is to find results that might aid regulators in determining the degree of restrictions they should place on the options markets and to aid traders in devising trading strategies that might earn excess profits.

The purpose of this dissertation, then, was twofold. The first was to study the daily returns of underlying

stocks in the two weeks surrounding the option expiration date. The intent of the empirical work was to substantiate the hypothesis of abnormal negative returns in the expiration week followed by abnormal positive returns in the subsequent week. It was shown that this return pattern should be expected due to the enhanced opportunity for and profitability of position unwinding, arbitrage and manipulation as the expiration day approached. The empirical results support this hypothesis and in particular show that the most significant negative return behavior occurs on Thursday and Friday of the expiration week.

The second purpose of the dissertation was to correlate the suggested expiration induced events of position unwinding, arbitrage and manipulation with the return behavior of the individual underlying stocks. The intent was to show that those stocks which exhibited the greatest negative return effect in the expiration week were those stocks and related call options that were most heavily involved in position unwinding, arbitrage and manipulation activities. Due to the difficulty of measuring these activities directly, the relative extent of stock and option trading volume during the expiration week was suggested as surrogates for these three activities. Trading volume creates an environment for these activities and at the same time is indirect evidence that they are taking place. Two additional explanatory variables of the

expiration week return effect were included. These were the existence of dually listed options and the presence of put option trading; with a negative relationship hypothesized for the first one and a positive relationship for the second variable.

To test these relationships, a cross-sectional multiple regression model was formulated with the cumulative average residuals for the underlying stocks as the dependent variable. The results of the regression runs generally support the hypothesized functional relationships. Specifically, option volume, stock volume and the presence of dual listing, all of which enhance and are evidence of position unwinding, arbitrage and manipulation, are negatively related to the CAR's. The results also show that the presence of put option trading tends to offset the negative return effect produced by call options alone.

Conclusions and Implications

Chapter I cites three important contributions of the dissertation. One contribution is the use of daily return data which allows a more refined analysis of the relationship between underlying stock price behavior and the option expiration. The second contribution deals with modeling and verifying a functional relationship between several variables that are shown to explain a significant portion of the return variability of the underlying stocks during

the expiration week. The third contribution is the use of an expanded sample and a more recent data base than used in prior studies. This is particularly important due to the extensive increase in put option trading beginning in mid-1980. Prior studies were basically dealing with the effect of only call options.

The results of the study show that the use of daily data has, indeed, provided some heretofore hidden information. While Klemkosky (1978) has shown that there is a negative return effect for the expiration week as a whole, this study has provided additional insight in showing that the negative effect is most significant on Thursday and Friday. The implication is that there is a rising tide of activity that builds during the expiration week and reaches its apex in the final two days prior to expiration. This result is not surprising in that all option holders must make a decision as to the disposition of their options before the final bell on Friday. The profitability of the disposition alternative they choose often becomes clearer in the later part of the week as the option value gradually becomes solely dependent on its intrinsic value. Therefore, position unwinding and exercising tend to culminate late in the expiration week.

In addition, and related to this late-week increase in position unwinding, profitable arbitrage and manipulation opportunities increase as the expiration hour

approaches. As position unwinding increases, options tend to deviate from their intrinsic value creating arbitrage opportunities. Also, the closer is the expiration hour, the greater are the leverage effects in trading options. This creates an increasing incentive for manipulation as the expiration week winds to a close on Friday.

This study substantiates Klemkosky's (1978) findings of an abnormal positive return effect in the subsequent week. However, the use of daily data in this study, again, provides some additional insights. Although the results show that, for the week as a whole, the underlying stock returns were positive, the turnaround did not begin until Tuesday. The negative results on Monday (day +1) are unexpected given the theoretical basis explained in Chapter III. The negative Monday returns, however, may be just further evidence of the "weekend effect" discussed by French (1980) and Gibbons and Hess (1981). They discussed a pattern in intra-week common stock returns that appears to be inconsistent with any reasonable model of capital market equilibrium. In particular, they find that the expected return on common stocks is influenced by the day of the week and is, in fact, negative on Mondays.

A second insight provided by the use of daily data is that, while positive returns were found on Tuesday through Friday (days +2 - +5), none were significant. This result may imply that it takes longer than one week for the

market to return to a state of equilibrium. Nevertheless, the positive abnormal returns on Tuesday through Friday seem to imply a reaction to the selling pressures of the six preceding days. Upward price pressure during the subsequent week may also be due to the establishment of new stock and option positions--a reversal of the closing transactions that predominate in the expiration week.

Several conclusions can be drawn from the results of the second major contribution of this dissertation which deals with modeling the functional relationship between the negative expiration week returns and several hypothesized explanatory variables. The results provide evidence that there is a significant relationship between expiration week underlying stock returns and relative stock and option volume, presence of dual listing and presence of puts trading. This result plus the aggregate results from the stage 1 tests suggest the following implication. With just the stage 1 results, showing negative abnormal returns from day -4 to +1 and positive returns from day +2 to +5, it is unlikely that they could provide the basis for a profitable trading strategy. First, the abnormal returns are not large enough to earn excess profits on if the trader has to pay for transactions costs and search costs. Secondly, even if these costs were insignificant, to profit from the stage 1 results, the trader would theoretically have to invest in 138 stocks over a four year period in an attempt to simulate

this study. Due to the wide variation in individual stock performance in the days surrounding the expiration, the trader would have to invest in a large sample of underlying stocks over several years. In sum, knowledge of the stage 1 results probably are of minimal value in devising a profitable trading strategy.

However, knowledge of the stage 2 results may provide the basis for devising a profitable trading strategy. This is because the functional relationship discovered here may aid the trader in determining the individual stocks that are likely to have the largest price reaction to the expiration. In other words, by observing the option and stock trading volume during the expiration week and by observing whether duals and puts are present, the trader may be better able to pick those securities that are likely to have a price reaction that is significant enough to profitably exploit. In sum, because certain securities appear to be more severely affected by the option expiration than others, and because certain observable variables appear to explain this price effect, the functional relationship shown in this study may aid traders in earning excess profits. It should be noted, however, that the "presence of puts" as an explanatory variable may have reduced significance in the future as the overwhelming majority of optioned stocks have puts traded with increasing trading volume.

A further result of the stage 2 tests is the apparent offsetting effect that put options have on the underlying stock returns in the expiration week. As the results in Chapter VI show, a sample portfolio consisting of stocks with both puts and calls traded is virtually unaffected by the expiration event while a sample portfolio with calls only is significantly negatively affected by the expiration.

The implication of this is that prior to the proliferation of put option trading beginning in mid-1980, the concern of regulators over expiration-induced stock return effects may have been partially warranted. Although even then, the impact of call options on underlying stocks was probably not great enough for the average investor to be hurt by them or to profit from them. Now, however, it appears that regulatory concern is basically unwarranted since puts are traded on almost all underlying stocks. With the advent of puts, the complaints regarding the adverse effects on stocks due to options trading should diminish significantly. As the number of and trading volume in puts continues to expand, the problem should be self-correcting.

Suggestions for Future Research

The following suggestions for future research grow out of and are partially influenced by certain limitations of this study. The suggestions also present ideas for

further refinements of the methodology and data as well as giving ideas regarding exploration of related issues.

The scope of this study has been limited to an investigation of the option expiration effect on underlying stock returns. A further extension of this would be to study how the expiration event affects the volatility of the underlying stocks. Related to this, it is suggested that a future investigation look more closely at the apparent decline in underlying stock betas that occurred simultaneous to the introduction of put options.

Another suggestion is to attempt to identify additional variables that may explain the abnormal return behavior in the expiration week. A variable that appears to be important is the number of exercises that occur during the expiration week. This variable could be studied more closely if the data availability problem which this author encountered can be overcome.

Additional work needs to be done in developing a theoretical basis for the relationship between the return generating process and trading volume. Future research might also attempt to more accurately and definitively link the abnormal stock price reaction to the specific expiration week events such as arbitrage, position unwinding and manipulation. This study is limited in that it uses trading volume in options and stocks as surrogates for these events. The difficulty would be in finding and quantifying data on

the extent of arbitrage and manipulation activity during the expiration week. Position unwinding activity is potentially available from the various option exchanges.

Finally, the methodology and data base could be refined and improved. Specifically, a time interval shorter than daily, such as hourly, could be used in an attempt to measure more precisely the correlation between an expiration induced event (manipulation or arbitrage) and the price reaction in the underlying stock. The ability to engage in such a study is now feasible given the transaction by transaction price data bases that are becoming available for both stocks and options.

APPENDIX A

SAMPLE FIRMS

Cycle 1 Firms

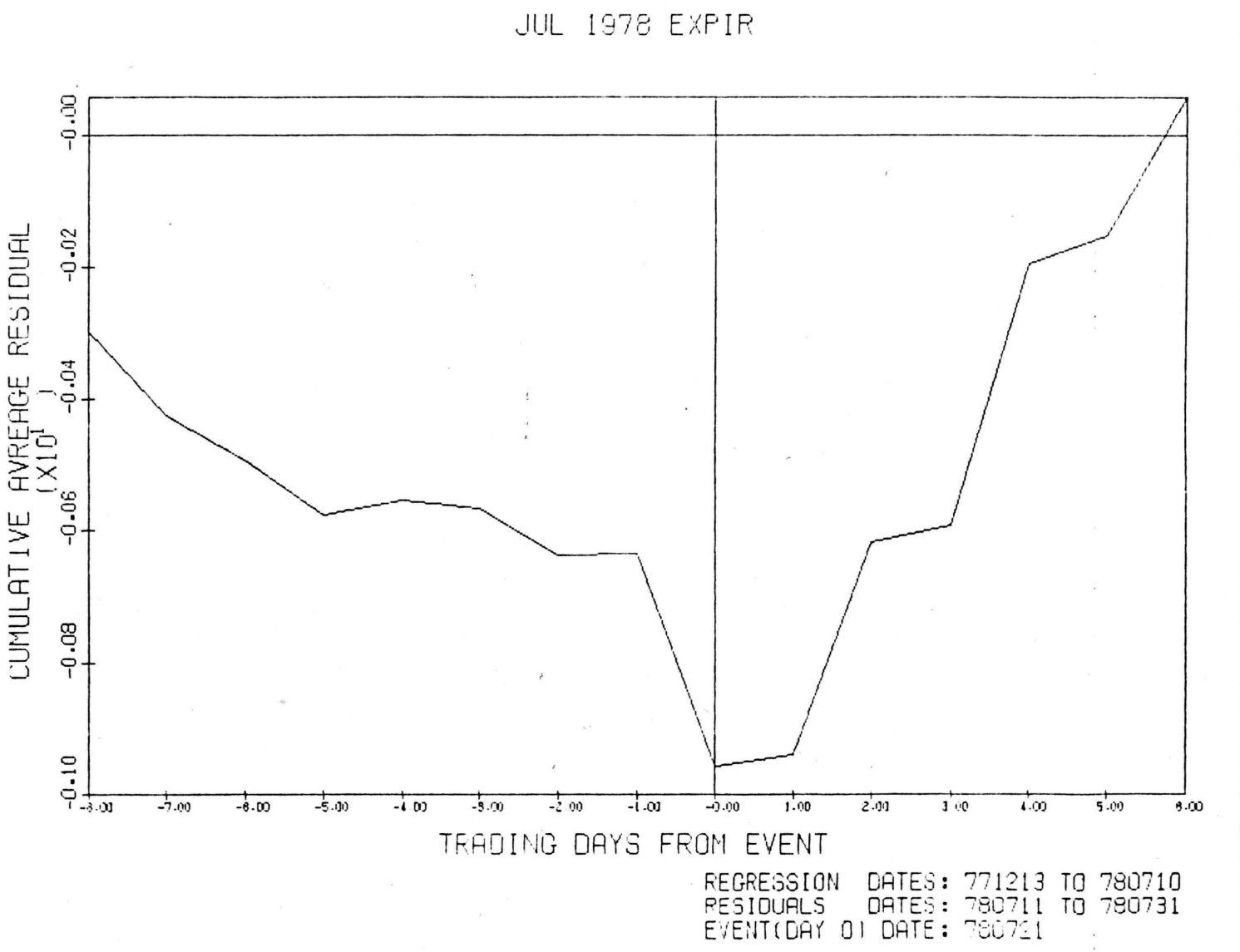
Aluminum Co. America
American Cyanamid
American Express
American Home Products
American Tel. & Teleg.
Ashland Oil & Refng.
Atlantic Richfield
BAnkamerica Corp.
Bethlehem Steel
Blue Bell
Burlington Northern
Burroughs
First Natl. City Corp.
City Investing
Communications Satel.
Continental Tel.
Delta Air Lines
Diamond Shamrock
Digital Equipment
Disney Walt Prodtns.
Dresser Inds.
Du Pont
Duke Power
Eastern Gas & Fuel
Eastman Kodak
Federal Natl. Mtg.
First Charter Finl.
Fluor Corp.
G A F Corp.
Georgia Pacific
Goodyear Tire & Rubr.
Great Western Finl.
Greyhound Corp.
Gulf Oil
Halliburton
Homestake Mining
I N A Corp.
I B M
Intl. Harvester
Intl. Minerals & Chem.
Intl. Paper
Johnson & Johnson
Kerr McGee
Lilly Eli & Co.
Mid Amer. Pipeline
Merck
Merrill Lynch
Minnesota Mng. & Mfg.
Monsanto Chem.
Motorola
Northwest Airlines
Pennzoil
Pepsico Inc.
Phelps Dodge
Pitney Bowes
Polaroid Corp.
Procter & Gamble
Scott Paper
Sperry Rand Corp.
T R W Corp.
Tandy
Teledyne
Texaco
Texas Instruments
Union Carbide
Union Oil Co.
United States Steel
Upjohn
Virginia Elec. & Pwr.
Warner Lambert
Western Union
Weyerhaeuser
Xerox Corp.

Cycle 2 Firms

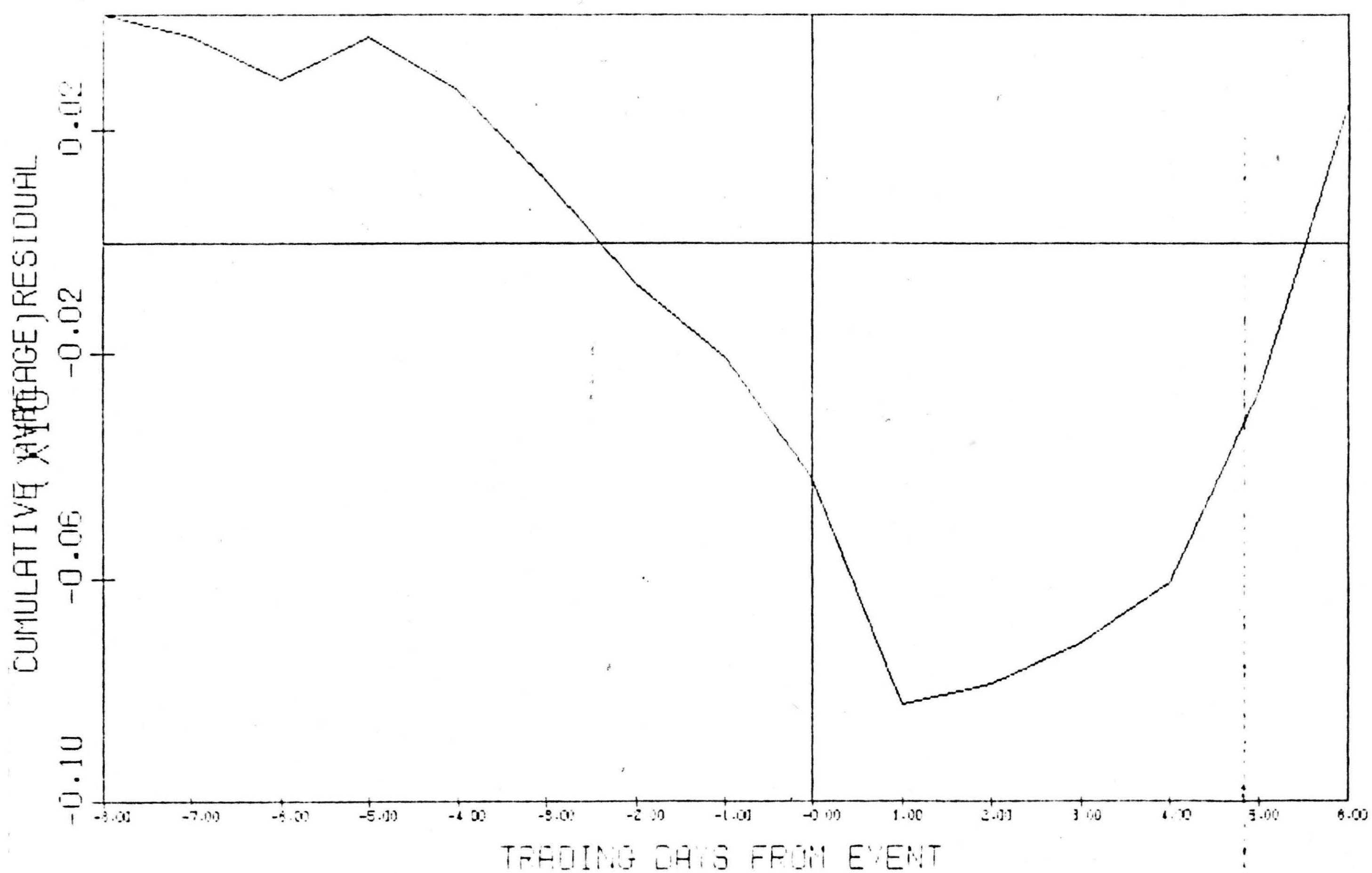
A M F Inc.
Abbott Labs
American Elec. Pwr.
American Hosp. Supply
A M P Inc.
Avnet Electrs.
Bally Mfg.
Baxter Labs
Black & Decker
Boeing
Boise Cascade
C B S Inc.
Caterpillar Tractor
Coca Cola
Colgate Palmolive
Commonwealth Edison
Consolidated Edison
Control Data Corp.
Dr. Pepper
El Paso Natl. Gas
General Dynamics
General Foods
Grace W R & Co.
Hewlett Packard
Hilton Hotels
Holiday Inns
Honeywell
Intl. Flavors & Frags.
Joy Mfg.
Louisiana Ld. & Expl.
Louisiana Pacific
M G I C Inc.
McDermott J R
McDonnell Aircraft Corp.
Mobil
N L Industries
National Semiconductor
Norton Simon
Occidental Petroleum
P P G Industries
Penney J C
Phillips Petroleum
Raytheon Co.
Reynolds R J
Reynolds Metals Co.
Schlumberger Ltd.
Searle G D
Signal Oil & Gas
Skyline Homes Inc.
Southern Co.
Standard Oil of Ind.
Sterling Drug
Sun Oil Co.
Tenneco Inc.
Texasgulf
Tiger Intl.
Transamerica Corp.
Travelers Corp.
United Air Lines
Union Pacific
United Technologies
Walter Jim Corp.
Williams Co.
Woolworth F W
Zenith Radio

APPENDIX B

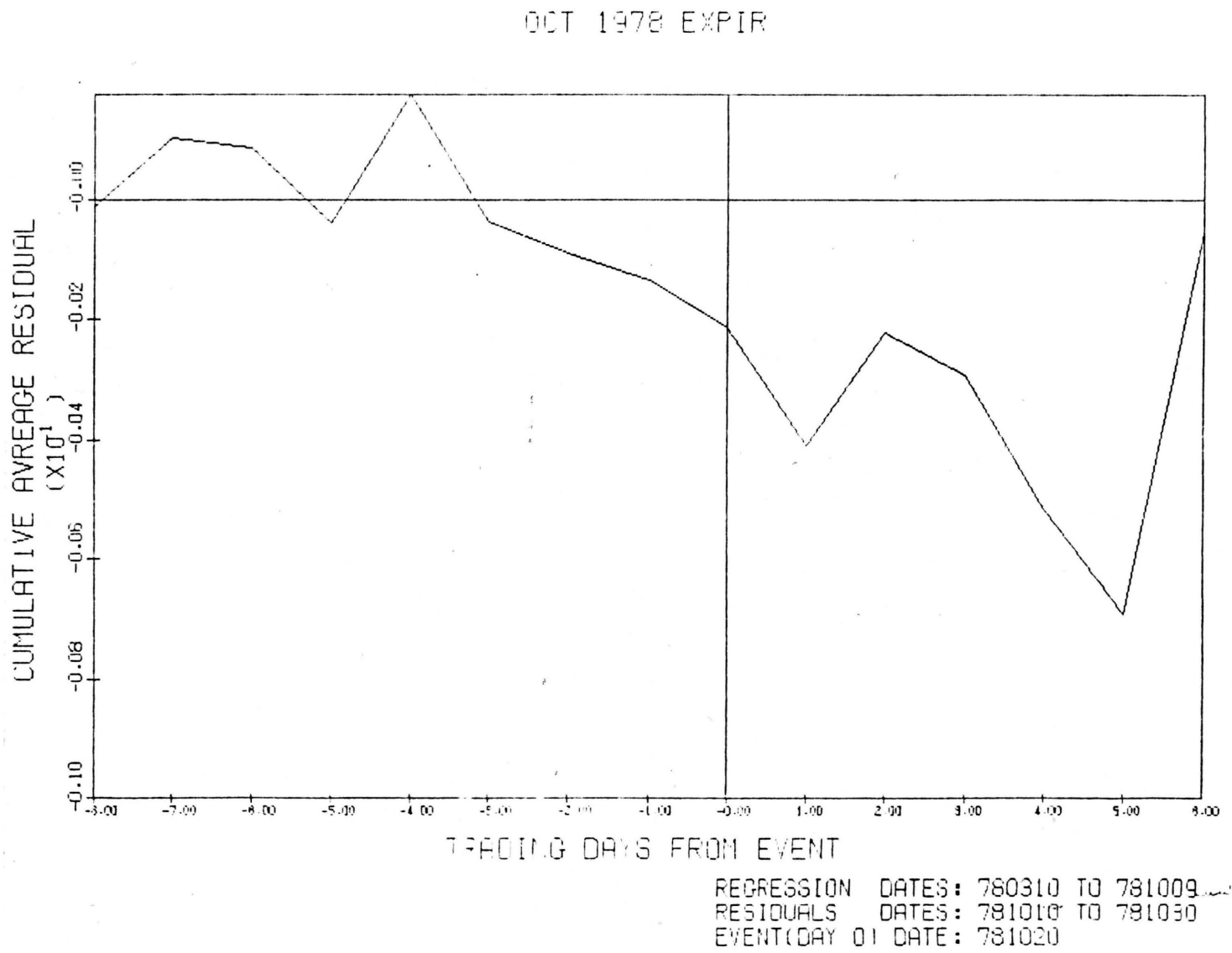
CAR PLOTS FOR INDIVIDUAL EXPIRATION MONTHS


JUL 1978 EXPIR
CUMULATIVE AVREAGE RESIDUAL
(X10)
-0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-8.00
-7.00
-6.00
-5.00
-4.00
-3.00
-2.00
-1.00
-0.00
1.00
2.00
3.00
4.00
5.00
6.00
TRADING DAYS FROM EVENT
REGRESSION DATES: 771213 TO 780710
RESIDUALS DATES: 780711 TO 780731
EVENT(DAY 0) DATE: 780721

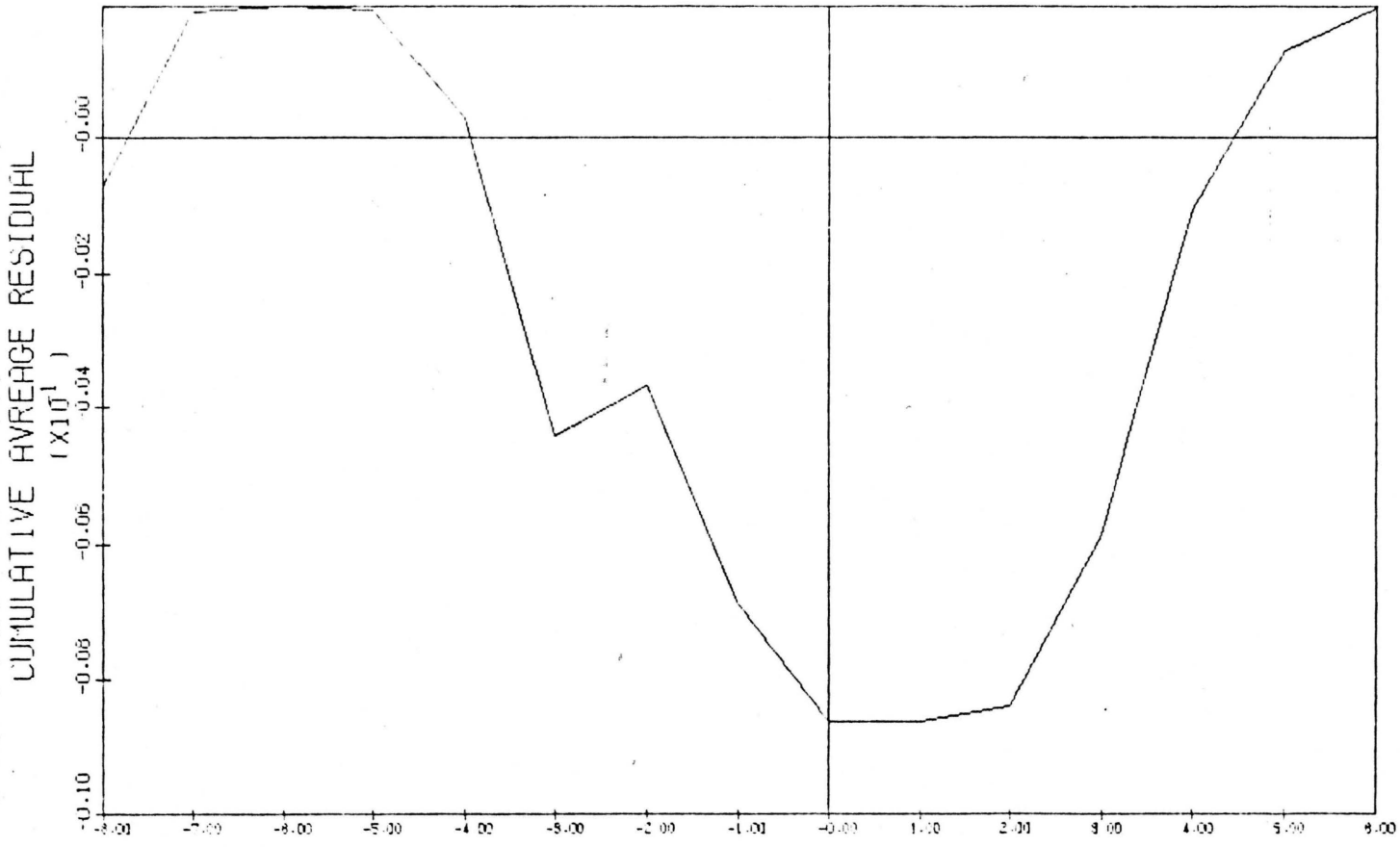
AUG 1978 EXPIR



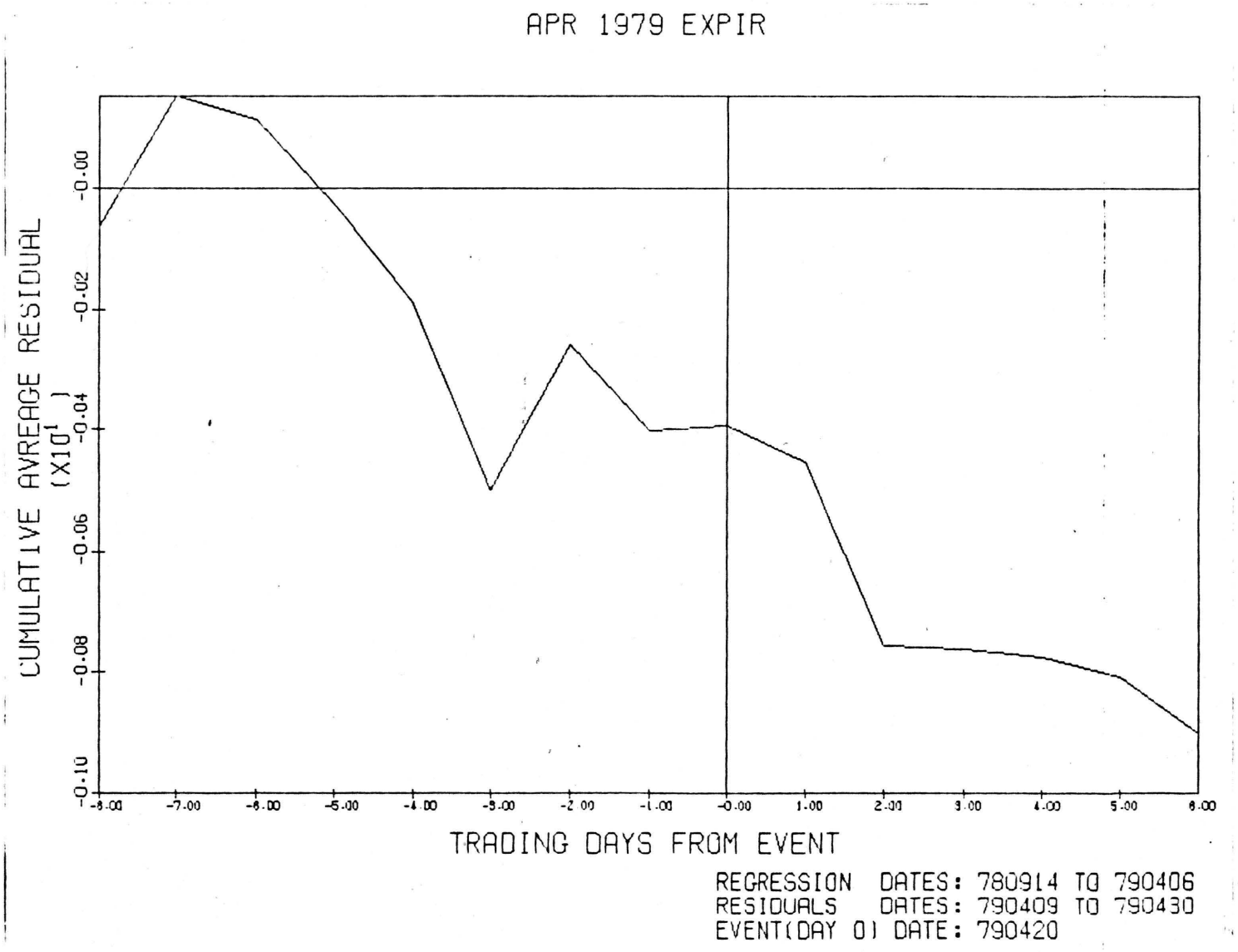
REGRESSION DATES: 780112 TO 780807
RESIDUALS DATES: 780808 TO 780828
EVENT(DAY 0) DATE: 780818

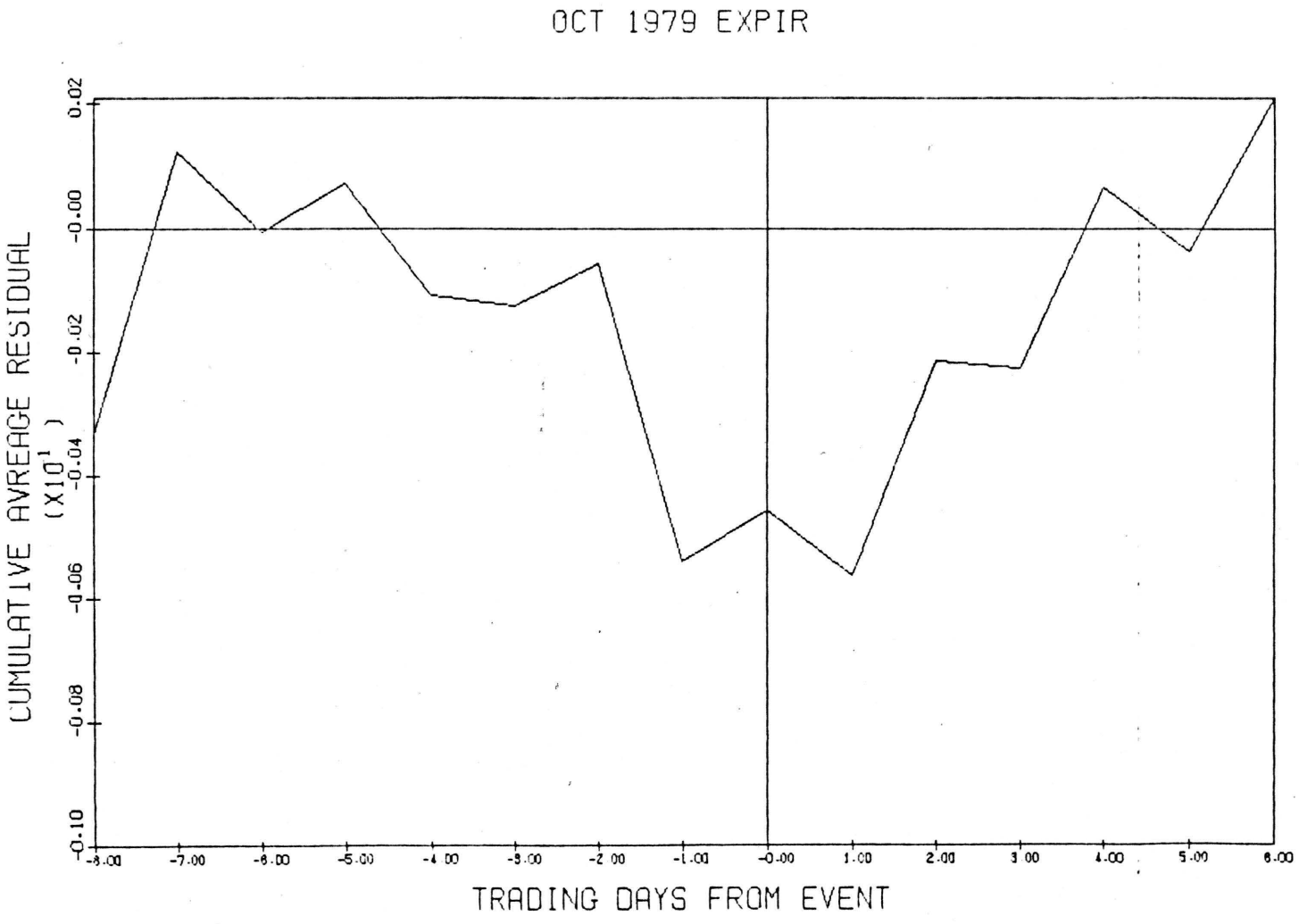

OCT 1978 EXPIR
CUMULATIVE AVREAGE RESIDUAL
(X10^{1})
-0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-8.00
-7.00
-6.00
-5.00
-4.00
-3.00
-2.00
-1.00
-0.00
1.00
2.00
3.00
4.00
5.00
6.00
TRADING DAYS FROM EVENT
REGRESSION DATES: 780310 TO 781009
RESIDUALS DATES: 781010 TO 781030
EVENT(DAY 0) DATE: 781020

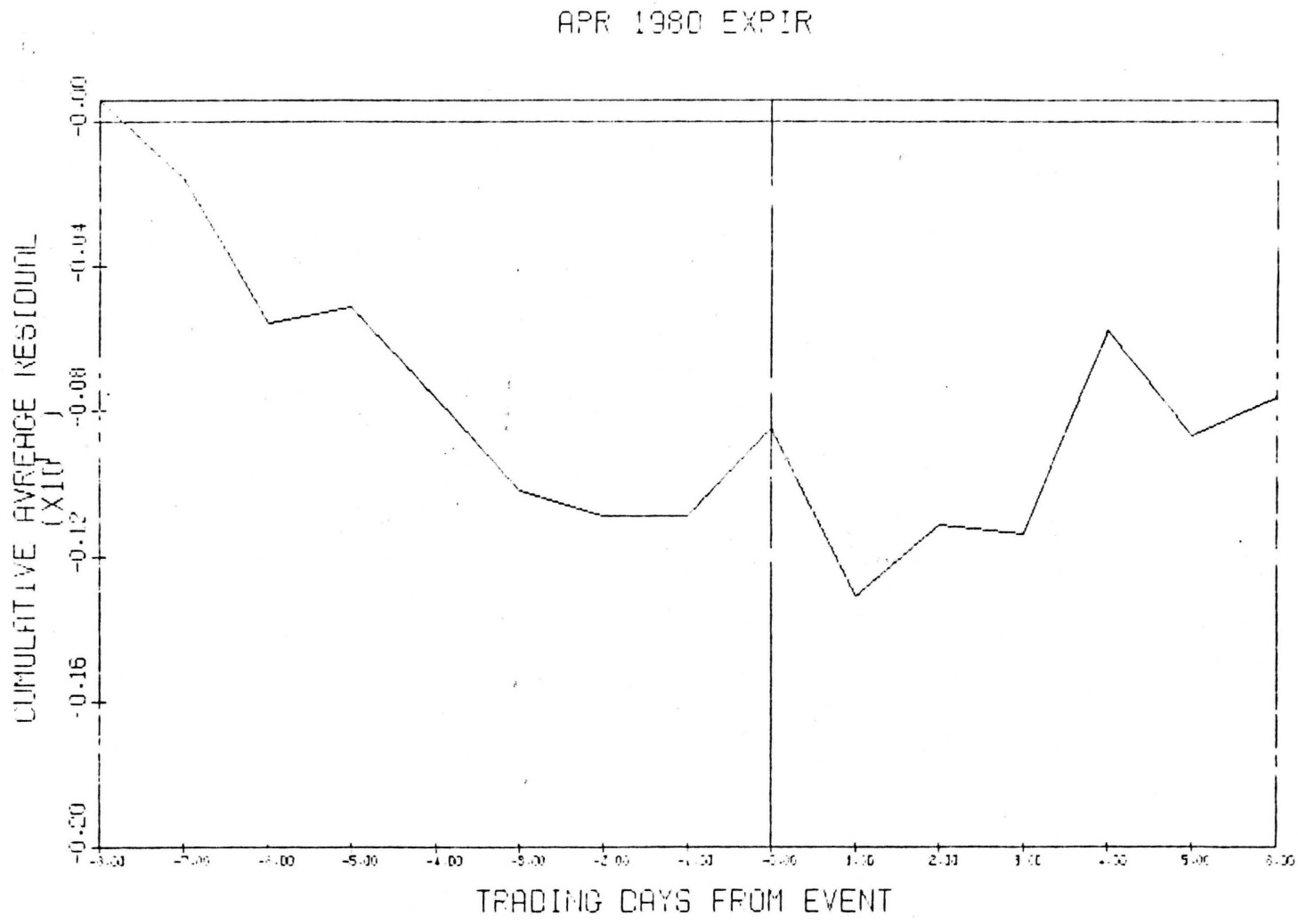
NOV 1978 EXPIR

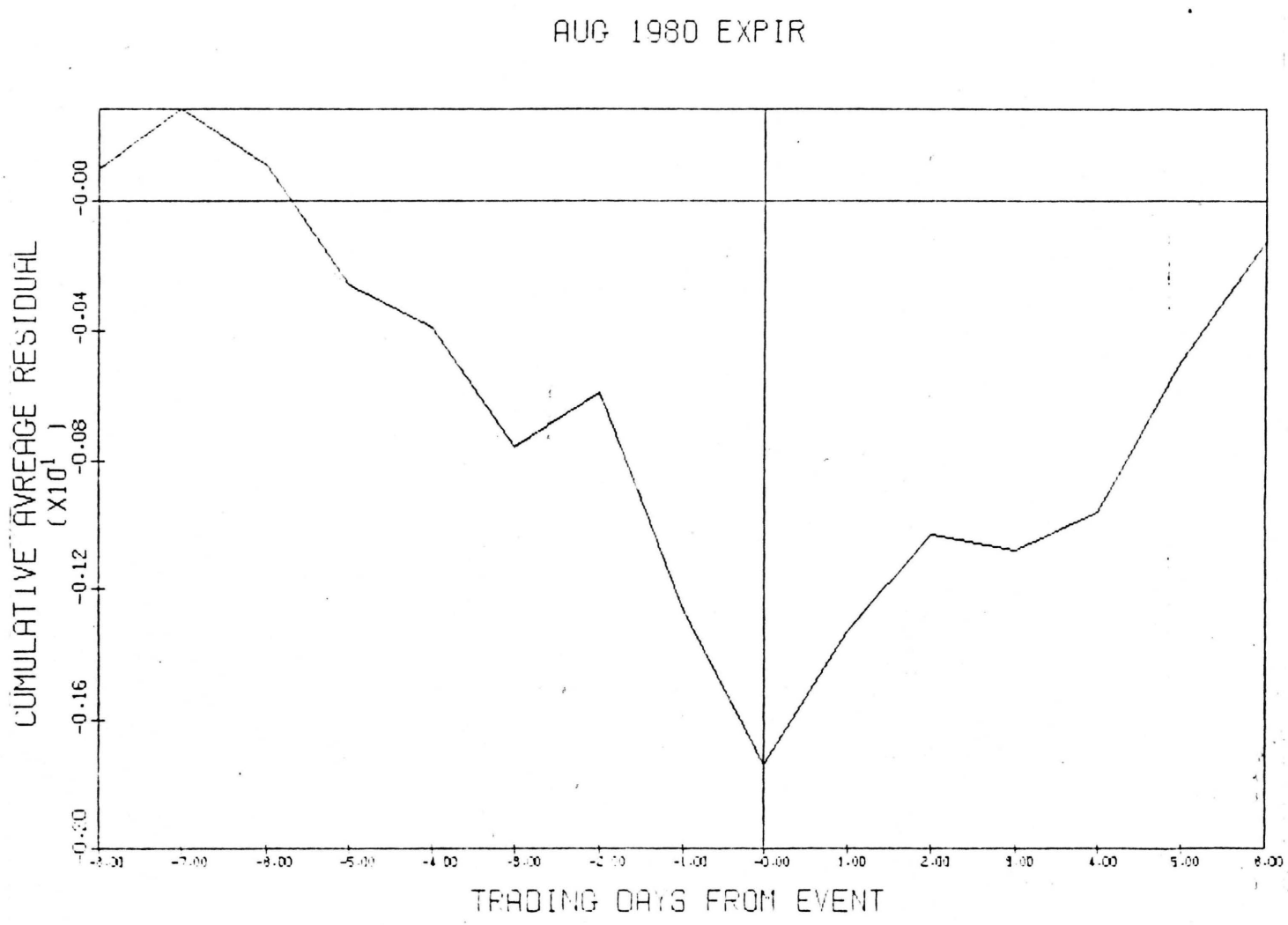


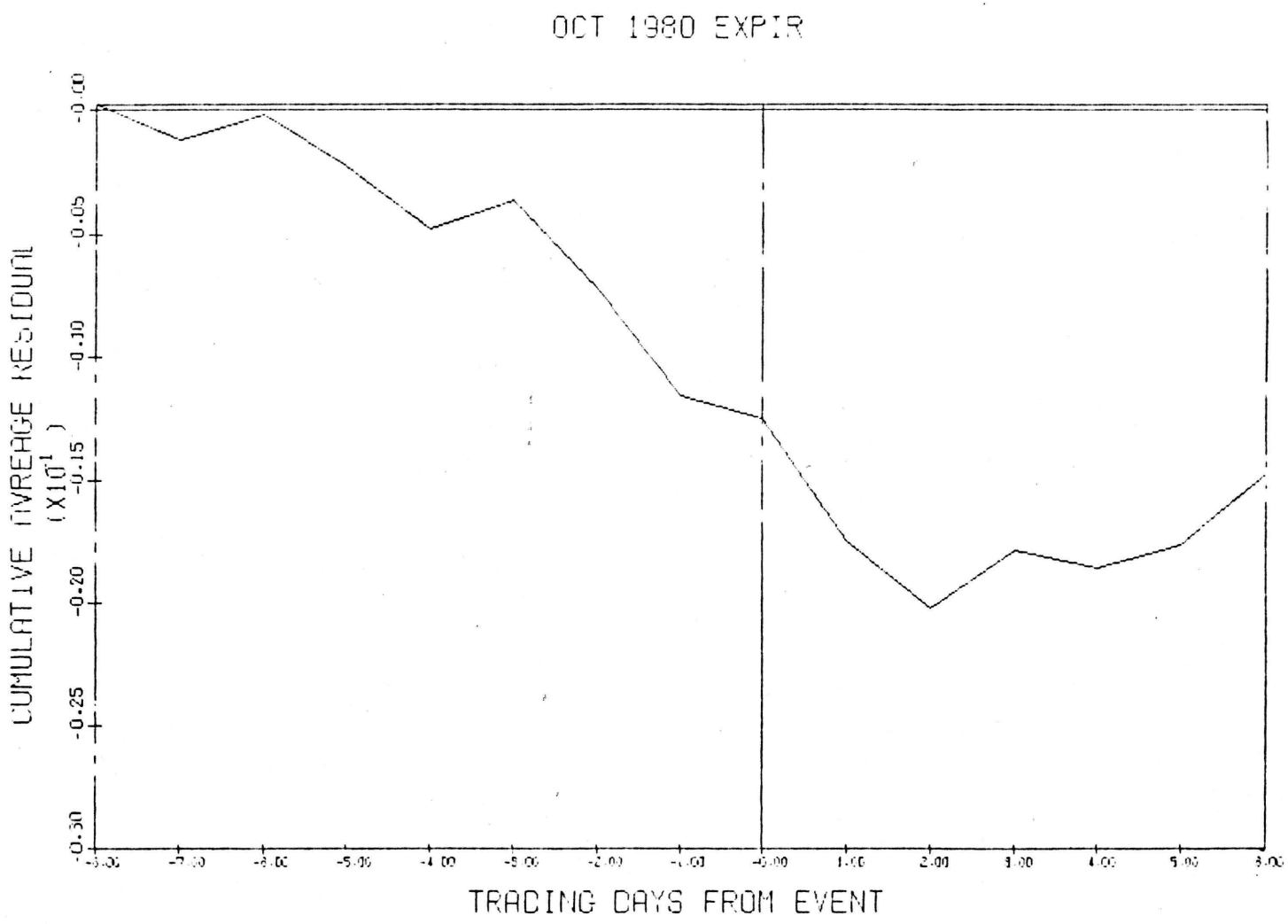
REGRESSION DATES: 780410 TO 781106
RESIDUALS DATES: 781107 TO 781128
EVENT(DAY 0) DATE: 781117

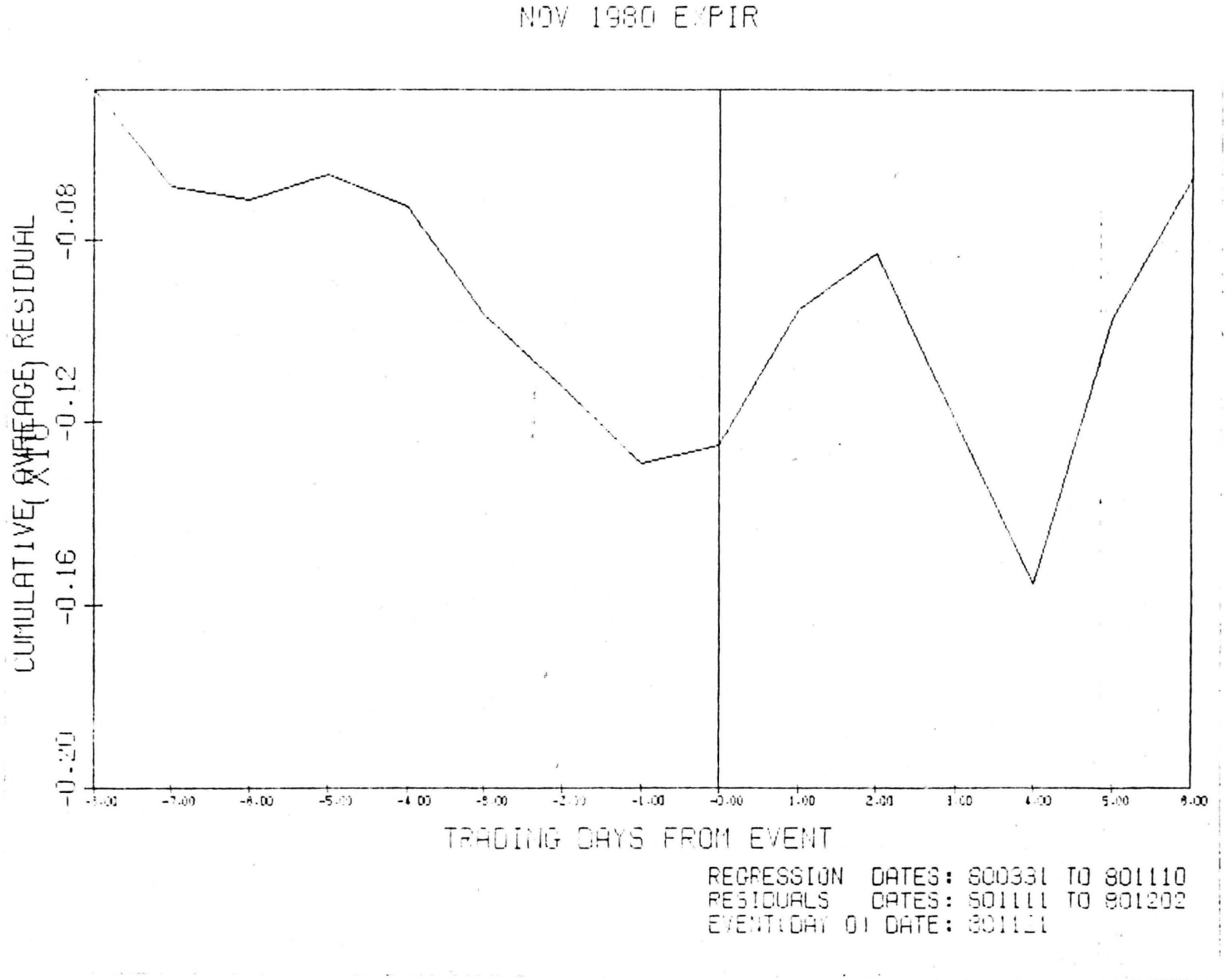

APR 1979 EXPIR
CUMULATIVE AVREAGE RESIDUAL
(X10^{1})
-0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-8.00
-7.00
-6.00
-5.00
-4.00
-3.00
-2.00
-1.00
-0.00
1.00
2.00
3.00
4.00
5.00
6.00
TRADING DAYS FROM EVENT
REGRESSION DATES: 780914 TO 790406
RESIDUALS DATES: 790409 TO 790430
EVENT(DAY 0) DATE: 790420


OCT 1979 EXPIR
CUMULATIVE AVREAGE RESIDUAL
(X10^{-1})
0.02
-0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-8.00
-7.00
-6.00
-5.00
-4.00
-3.00
-2.00
-1.00
-0.00
1.00
2.00
3.00
4.00
5.00
6.00
TRADING DAYS FROM EVENT
REGRESSION DATES: 790307 TO 791008
RESIDUALS DATES: 791009 TO 791029
EVENT(DAY 0) DATE: 791019

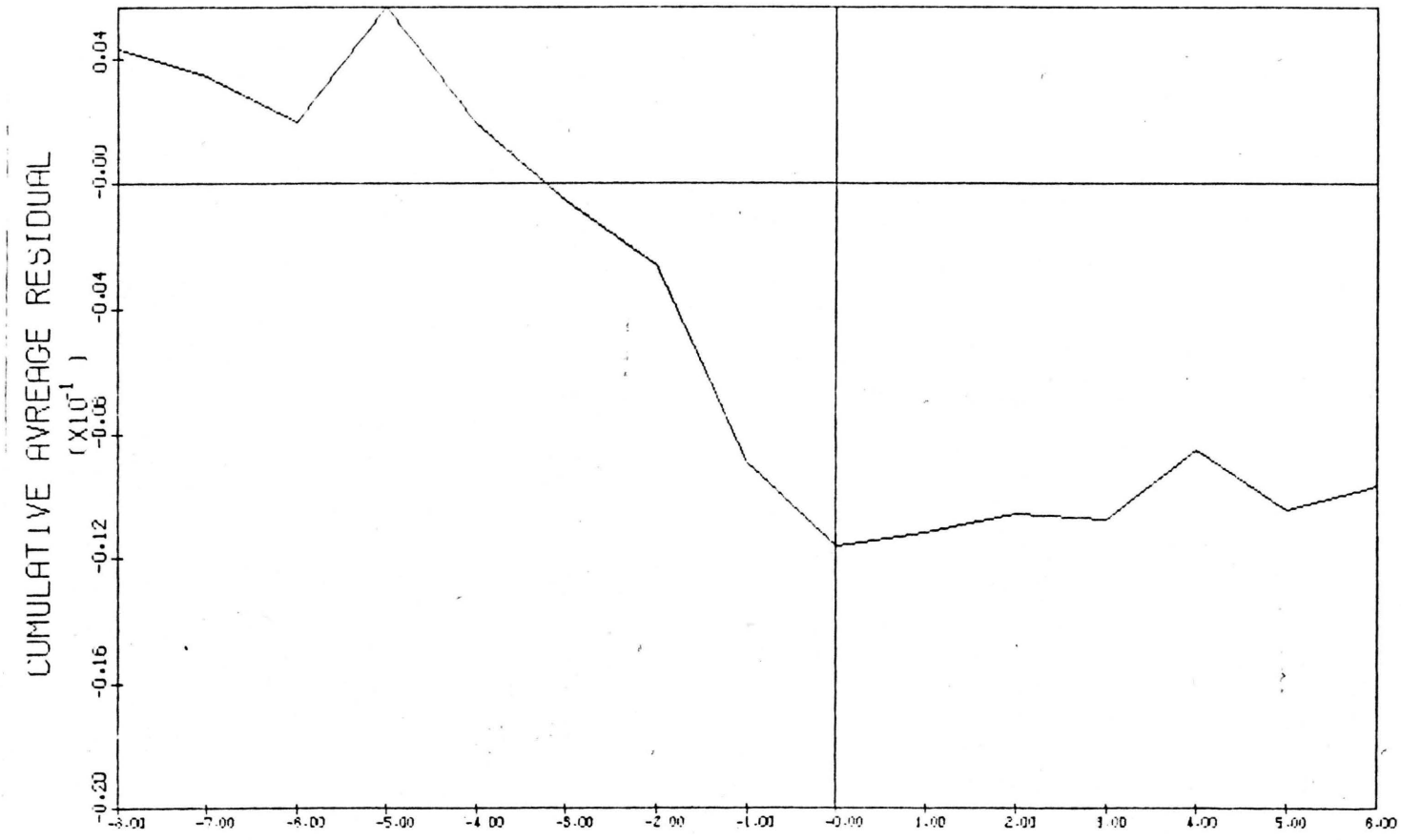

APR 1980 EXPIR
CUMULATIVE AVERAGE RESIDUAL
(XID)
-0.00
-0.04
-0.08
-0.12
-0.16
-0.20
TRADING DAYS FROM EVENT
REGRESSION DATES: 790927 TO 800407
RESIDUALS DATES: 800408 TO 800428
EVENT(DAY 0) DATE: 800418


AUG 1980 EXPIR
CUMULATIVE AVREAGE RESIDUAL
(X10¹)
-0.00
-0.04
-0.08
-0.12
-0.16
-0.20
-8.00
-7.00
-6.00
-5.00
-4.00
-3.00
-2.00
-1.00
-0.00
1.00
2.00
3.00
4.00
5.00
6.00
TRADING DAYS FROM EVENT
REGRESSION DATES: 800104 TO 800804
RESIDUALS DATES: 800805 TO 800925
EVENT-DAY 0: DATE: 800815

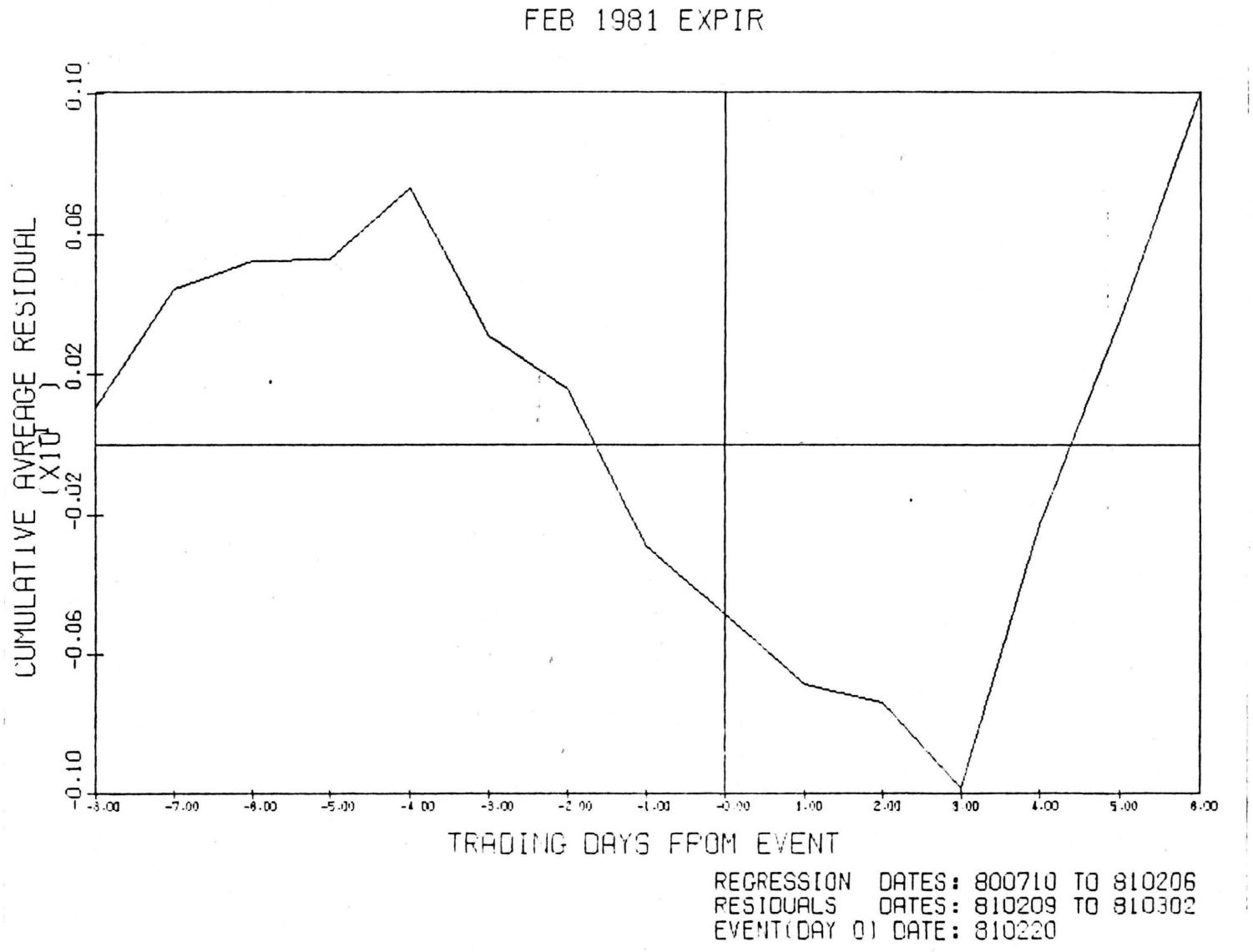

OCT 1980 EXPIR
CUMULATIVE AVREAGE RESIDUAL
(X10^{-1})
-0.00
-0.05
-0.10
-0.15
-0.20
-0.25
-0.30
TRADING DAYS FROM EVENT
REGRESSION DATES: 800303 TO 801006
RESIDUALS DATES: 801007 TO 801027
EVENT-DAY 0 DATE: 801017

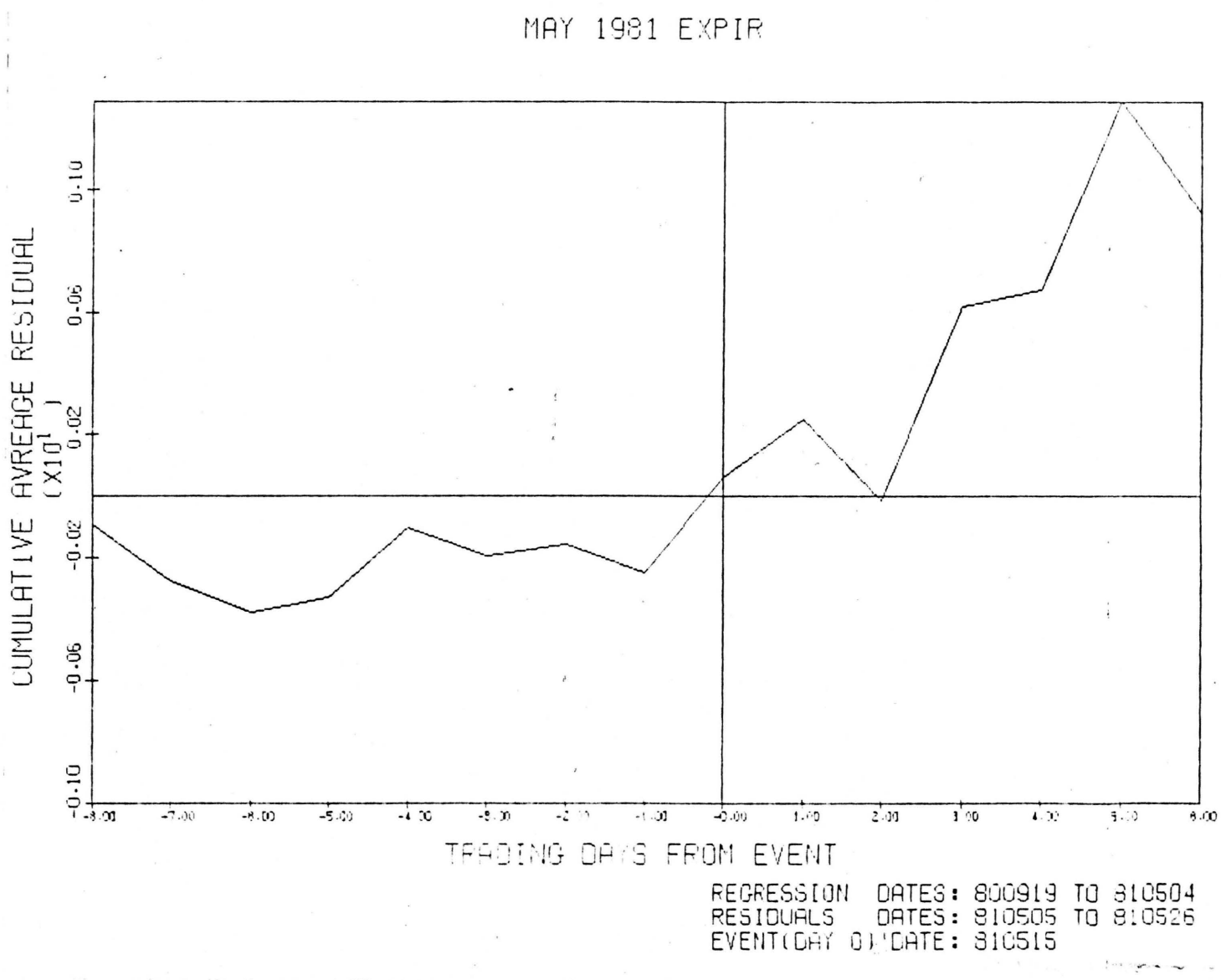

NOV 1980 EXPIR
CUMULATIVE (AVERAGE) RESIDUAL
-0.08
-0.12
-0.16
-0.20
-8.00
-7.00
-6.00
-5.00
-4.00
-3.00
-2.00
-1.00
-0.00
1.00
2.00
3.00
4.00
5.00
6.00
TRADING DAYS FROM EVENT
REGRESSION DATES: 800331 TO 801110
RESIDUALS DATES: 801111 TO 801202
EVENT(DAY 0) DATE: 801121

JAN 1981 EXPIR



REGRESSION DATES: 800611 TO 810105
RESIDUALS DATES: 810106 TO 810126
EVENT(DAY 0) DATE: 810116


FEB 1981 EXPIR
CUMULATIVE AVREAGE RESIDUAL
(X10)
0.10
0.06
0.02
-0.02
-0.06
-0.10
-8.00
-7.00
-6.00
-5.00
-4.00
-3.00
-2.00
-1.00
-0.00
1.00
2.00
3.00
4.00
5.00
6.00
TRADING DAYS FROM EVENT
REGRESSION DATES: 800710 TO 810206
RESIDUALS DATES: 810209 TO 810302
EVENT(DAY 0) DATE: 810220


MAY 1981 EXPIR
CUMULATIVE AVREAGE RESIDUAL
(X10[1])
0.10
0.06
0.02
-0.02
-0.06
-0.10
-8.00
-7.00
-6.00
-5.00
-4.00
-3.00
-2.00
-1.00
-0.00
1.00
2.00
3.00
4.00
5.00
6.00
TRADING DAYS FROM EVENT
REGRESSION DATES: 800919 TO 810504
RESIDUALS DATES: 810505 TO 810526
EVENT(DAY 0)'DATE: 810515

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