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Earnings Announcements, Stock Price Adjustment, and the Existence of Option Markets

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ABSTRACT

This paper employs a new approach to study the effects of option trading on the behavior of underlying stock prices. Extant research compares distributional properties of the stock price at two points in time divided by an event in the option market that might affect price behavior. As an alternative, we examine the stock price adjustment to the release of quarterly earnings using samples of firms with and without listed options. We find the two samples exhibit different adjustment processes, with the nonoption firms requiring substantially more time to adjust.

SINCE THE ADVENT OF organized stock option trading, the investment community has been concerned about the effect of option trading on the underlying stocks' price behavior. This concern is shared by both the exchanges trading options and the governmental organizations regulating this trading. It is justified by the role played by the secondary equity markets in allocating economic resources.[1] Empirical investigations of options' effects compare stock price behavior at two points in time separated by an event that might affect this behavior. The most common events studied are option listing and option expiration. In the first case, stock price distributional properties before and after the option listing (or the intention to list) date are compared. In the latter, the stock price behavior around option expiration dates is compared to its behavior in nonexpiration periods. Deviations in behavior from pre-event "norms" generally are interpreted as potentially damaging to economic efficiency.[2] Our study, while also empirical, takes a different tack. We examine the stock price adjustment process initiated by quarterly earnings announcements with two samples of firms: one having exchange-listed options and another without exchange-listed options. Our findings show that the adjustment processes differ between the two groups.

Two early studies on the effect of option trading on stock price behavior (the Nathan Report [9] and a CBOE study [1]) concluded that exercising options had no impact on the underlying stocks' price movements. Recent studies, however, report evidence of abnormal stock market activity during expiration week. A

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[1] See Securities and Exchange Commission Release Number 14056, dated November 17, 1977.

[2] See Klemkosky and Maness [7, p. 12] and Officer and Trennepohl [11, pp. 75–76], for a more complete discussion.

Securities and Exchange Commission study [16] found evidence of abnormal stock price activity in the week preceding expiration. Klemkosky [6] (using weekly data), and Officer and Trennepohl [11] (with daily data) employed residual analysis techniques and found abnormally negative stock returns in expiration week.

One concern when comparing stock price behavior around option listing seems to be that the listing of an option is associated with an increase in stock price volatility. Research by Klemkosky and Maness [7], Trennepohl and Dukes [18], and Whiteside, Dukes, and Dunne [19] (WDD) provides no basis for this concern. Evidence regarding the effect of option listing on the trading volume is mixed. WDD found no significant change while Hayes and Tennenbaum [4] document an increase in volume.

The studies cited hypothesize that organized option trading may affect the efficiency of secondary equity markets and document some evidence of "non-normal" activity related to option listing and expiration. Manaster and Rendleman [8] (MR), however, suggest a scenario where option trading may improve market efficiency. They argue that the option market may affect the manner in which stock prices adjust to the release of information relevant to firm valuation. The logic of their argument follows.

If some traders believe the option market provides a superior investment vehicle (because of transactions costs, leverage, liquidity, or short sales restrictions), they may execute their investment strategies using options as a substitute for or supplement to stock positions. These option market "plays" may move option premia out of equilibrium relative to the underlying stocks' prices. If the premia become far enough "out of line," arbitrageurs intervene to realign stock and option prices. Thus, the option market may play an important role in determining equilibrium stock values. MR test and reject the hypothesis that the equilibrium stock prices implied by option premia provide no information regarding future stock price movements.

Work by Patell and Wolfson [12, 13] also provides evidence consistent with this hypothesis. They examine the time series behavior of the implied variance rate around the release of earnings. If investors believe that stock price volatility will likely increase because of earnings announcements, this expectation should be evident in the implied variance rate *prior* to the release of earnings. Furthermore, when the news is released, uncertainty is eliminated and the implied variance should fall. The results of the Patell and Wolfson studies are compatible with this scenario.

Thus, the available evidence is consistent with the arguments that: (1) options may be preferred to direct equity investment and (2) option premia appear to anticipate stock price changes. Given these findings, it seems reasonable that a researcher could detect differences in the adjustment of stock prices to information releases, depending on whether or not an exchange-listed option existed for the stock. This is the issue we investigate.

We use a control portfolio methodology to compare the stock price behavior of option firms and nonoption firms. Since option exchanges do not randomly select firms for listing, this technique is essential. Generally, option exchanges select listing candidates based on attributes like investor interest, trading activity, and

stock price volatility. Therefore, we must consider these factors when conducting our analysis. Proxies for these characteristics are included as part of our control portfolio methodology.

In the next section, we discuss aspects of the stochastic process associated with common stock prices and how changes in this process may be used to study the adjustment of stock prices to information. In Section II, we introduce our data and empirical methodology. Our findings are presented in Section III. We conclude with a discussion of some of the implications of our study and some ideas for further work in this area.

I. Stock Price Behavior

Transaction stock prices exhibit strong negative serial correlation. That is, successive price *changes* tend to be of opposite sign. This tendency has been reported by several researchers.[3] Niederhoffer and Osborne [10] explain this phenomenon as being a natural consequence of the institutional structure of the financial markets.[4]

Patell and Wolfson [14] (PW) use changes in this stochastic process around information events to draw inferences about the speed of stock price adjustment. They do this by observing the time period over which a news release interrupts this negative serial correlation by increasing the frequency of successive price changes of the same sign.

In the stochastic process test, PW define the announcement period as the day an earnings or dividend announcement appears on the Broad Tape and the following day. The nonannouncement period consists of all other days in the sample period. They compute relative frequencies of continuances (successive price changes of the same sign) and reversals (successive price changes of opposite sign) for the nonannouncement period. Using χ^2 tests, PW compare these "normal" relative frequencies to the frequencies observed during the announcement periods. They are interested in the time that elapses before the relative frequencies of continuances and reversals during announcement periods are indistinguishable from their nonannouncement period counterparts.

Stochastic process tests consider signs of price changes but ignore magnitudes. PW use a variance test to examine the latter issue. In this test, they calculate empirical probability distributions of hourly price changes for each firm's stock during the nonannouncement period. Hourly price changes during the announcement period are examined to determine the period for which there exists an elevated frequency of "large" price changes. Large price changes are defined as those changes lying in the extreme 5% tails of the nonannouncement period's price change distribution.

[3] See, e.g., Cootner [2], Niederhoffer and Osborne [10], Patell and Wolfson [14], Jennings and Starks [5], and Smidt [17]. Roll [15] uses this negative serial correlation to examine the bid/ask spread component of transactions costs. French and Roll [3] note this source of serial correlation, but find it is not sufficiently pervasive to produce negative first-order correlation in all subsets of stock return data.

[4] For a more complete discussion, see Niederhoffer and Osborne [10] or Patell and Wolfson [14, pp. 226–7].

We use the stochastic process and variance tests as developed by PW on two stratified samples. A firm is classified as an option firm if its stock is the underlying asset for an exchange-listed option. A firm is denoted a nonoption firm otherwise. If the option market offers a viable alternative for informed investors, and if option trading affects stock prices, we would expect the option firms' stock to adjust to information releases at least as rapidly as the stock of firms without options.

II. The Data

We examine two time periods to decrease the time period specificity of our results. The first extends from June 15, 1981 through August 21, 1981 and represents a period of generally poor market performance and low trading volume. Our second interval is October 4, 1982 through December 31, 1982, a period of strong market performance and high volume. Our transaction stock price data were acquired from Francis Emory Fitch Corporation and consist of the price and volume of each transaction (with the to-the-minute time of occurrence) for all New York Stock Exchange (NYSE)-listed firms.

Before selecting the firms for our study, we reduced this universe. The firms in our sample should be reasonably widely held and actively traded. To provide some control for these factors, we limited our sample to NYSE-listed firms with exchange-listed options and nonoption NYSE-listed firms included in the Standard and Poor's (SP) 500 Index.[5] From these sets, we selected all firms releasing quarterly earnings announcements in our sample periods during NYSE trading hours.[6] Our source of the earnings announcements (and the associated release times) was the Dow Jones News Retrieval Service. Applying these restrictions during the 1981 period resulted in a sample of 150 firms with exchange-listed stock options and 84 firms without options. In 1982, we found 180 option and 99 nonoption firms.

Table I presents the frequency distributions of announcement times by hour during the day. A Mann-Whitney ranks test of the relative frequencies fails to reject the hypothesis that the observed distributions are drawn from the same underlying distribution using traditional levels of significance. This is true for each year and the overall period.

The portfolios of firms on which we perform the PW statistical tests are selected next. Since the nonoption firm sample size was smaller in both years, we took these firms as given and selected control portfolios with the same number of option firms. This implies we selected the 84 option firms (from the 150 option firms) in 1981 and the 99 option firms (from the 180) in 1982 that are most like the nonoption firm sample in certain "relevant" attributes.

[5] During our sample period, Chrysler and Textron (members of the SP 500) did not have exchange-listed options. Both firms, however, had warrants that may serve the same function. To avoid confusion, we excluded these firms.

[6] Patell and Wolfson [14] document different adjustment processes for announcements made during trading and nontrading hours. To avoid confounding these processes, we eliminated releases made in nontrading hours.

Table I

Release Time Relative Frequency (in percent)

	Announcements Occurring within Each Trading Hour:					
	1981		1982		Overall	
Time of Day	Option	Nonoption	Option	Nonoption	Option	Nonoption
10–11	22.0	27.3	21.7	16.2	21.8	21.2
11–12	30.7	14.3	24.9	20.3	27.5	17.6
12–1	19.3	19.0	15.6	23.2	17.3	21.3
1–2	10.0	15.5	18.3	13.1	14.6	14.2
2–3	9.3	15.6	11.7	18.2	10.6	17.0
3–4	8.7	8.3	7.8	9.0	8.2	8.7
	100.0	100.0	100.0	100.0	100.0	100.0

One attribute that seemed particularly relevant is investor interest/trading activity. We want our portfolios of option and nonoption firms to possess, as nearly as possible, the same level of interest/activity. Unfortunately, criteria for selecting option exchange listing candidates include high levels of investor interest and trading activity. Thus, stocks with listed options tend to be the most closely followed and actively traded. Selecting our nonoption firm sample from the SP 500 ensured that the nonoption firms had reasonable levels of both attributes. However, to match our option firm sample as closely as possible to the nonoption sample, we ranked the option firms (150 firms in 1981 and 180 in 1982) based on each of three characteristics and selected those that matched, on average, the nonoption firms as closely as possible. The three characteristics were: (1) firm capitalization (market value of equity) at year-end 1981 and 1982; (2) number of institutional investors holding the firm's stock in December 1981 and 1982; and (3) the number of transactions within our sample periods. After ranking the option firms on these criteria, we selected the 84 firms in 1981 and the 99 firms in 1982 that provided the closest match with the nonoption firms in our sample.[7] Table II provides some descriptive statistics of these characteristics for the option and nonoption firms in each time period.

Looking at the statistics for the market value and institutional holding variables reveals few consistent relationships across years. One consistency is that the largest and most widely held firms are from the nonoption samples. Closer examination of the sample firms reveals that this is due to the inclusion of a few large utility firms in the nonoption sample. Thus, comparing median values, instead of means, is probably more meaningful. Combining the time periods, the two groups appear similar in size and institutional holdings. The median firm value for the option firms is \$746 million compared to \$717 million for the nonoption firms. The option firms are slightly more widely held (a median of 136 institutions versus 113). Significance tests for differences in the medians were unable to reject the null hypothesis of no difference at the 0.10 level of significance for either variable.

[7] Using our characteristics for 1981 (1982), this amounted to selecting the 84 (99) option firms of the 150 (180) total having the smallest market values, the lowest levels of institutional holdings, and the least trading activity. A list of the sample may be obtained from the authors.

Table II

Summary of the Sample Firms' Characteristics

Characteristic/Sample	Minimum	Tenth Percentile	Median	Ninetieth Percentile	Maximum	Mean
1981 ($N = 84$)						
Market value*						
Option	$20	$328	$886	$1,504	$1,815	$921
Nonoption	$29	$135	$635	$1,497	$2,628	754
Institutions holding						
Option	1	72	168	266	282	164
Nonoption	19	33	108	230	459	128
Transactions						
Option	544	953	1,949	2,543	2,758	1,831
Nonoption	174	359	985	2,473	4,967	1,228
1982 ($N = 99$)						
Market value*						
Option	$52	$230	$650	$1,221	$1,366	$700
Nonoption	$71	$185	$745	$1,749	$3,385	$854
Institutions holding						
Option	14	63	123	195	208	131
Nonoption	15	36	115	256	367	126
Transactions						
Option	1,096	1,885	3,496	4,942	5,266	3,491
Nonoption	568	972	2,015	4,864	7,582	2,480

* In millions.

The relationship between the option and nonoption samples with regard to the number of transactions is very consistent. With the exception of the maximum point in the transaction distribution (once again due to the utility firms), the option firm samples dominate the nonoption firm samples. Looking at median values, the option firms are over 80% more actively traded (2,786 transactions compared to 1,542). The difference in the median number of transactions between the groups is significant at the 0.01 level.

Although options trading may increase the trading activity in the underlying stocks,[8] this difference in trading frequency is disturbing. In an effort to mitigate potential problems, we take a second approach to forming the trading-activity option-firm control portfolio. For each nonoption firm, we select the option firm with the number of transactions closest *from below* as a control firm. That is, the control portfolio is constructed so *each* option firm has fewer transactions than the nonoption firm with which it is matched.[9] Since the highest trading activity occurs among option firms, this reduces the sample size (to 41 in 1981 and 57 in 1982). This alternative control portfolio formation technique produces samples in which the median nonoption number of transactions is about 2% greater than the median for the option firm sample. Results are reported for both sampling methods.

III. Our Findings

A. The Stochastic Process Test

The idea of a price change sequence number is crucial to understanding the stochastic process test. Figure 1 illustrates this concept. Consecutive transaction prices are numbered one through eight (P1 through P8). Price change sequence numbers are assigned relative to the earnings announcement time (time $t = 0$) and calculated as indicated. Price change sequence number +1 illustrates that we ignore equivalent consecutive prices. In this case, we eliminate price change (P6–P5) and look at (P7–P5) instead.[10]

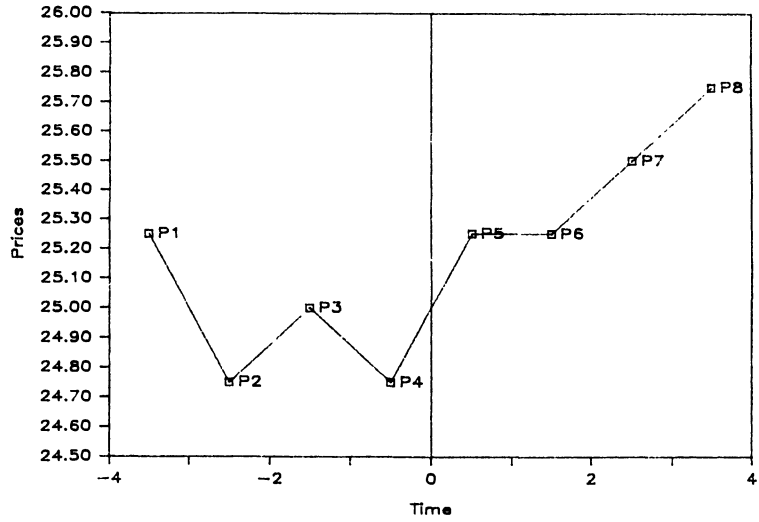
To perform the stochastic process test, we must establish the relative frequencies of continuances and reversals for each portfolio during the nonannouncement period. Table III provides this information. These results are consistent with previous studies that found a reversal two to three times as likely as a continuance.

In Figure 2, we present our findings in transaction time for the entire time period. (Subperiod results are similar.) Normalizing into transaction time is useful since trading frequency varies over time and between firms. Price change sequence numbers are assigned for all price changes in the two-day announcement

[8] The difference in activity may be exaggerated by the existence of option trading since many option strategies involve taking both stock and option positions. Thus, one would expect the trading activity in the stock for option firms to be greater than the activity for the nonoption firms even if the "stock position only" trading activity is identical.

[9] We thank a referee for this suggestion.

[10] See Figure 3 and the text on page 243 in Patell and Wolfson [14] for a further discussion. The treatment of zero changes is consistent with PW.



Price Change Sequence Number	Calculation	Conclusion
-2	(P3-P2) vs. (P2-P1)	Reversal
-1	(P4-P3) vs. (P3-P2)	Reversal
0	(P5-P4) vs. (P4-P3)	Reversal
+1	(P7-P5) vs. (P5-P4)	Continuance
+2	(P8-P7) vs. (P7-P6)	Continuance

Figure 1. Price Change Sequence Numbers

Table III

Nonannouncement Period Frequencies (Percent Continuance)

Sample	1981–1982	1981	1982
Nonoption firms	29.0	29.5	28.8
Option firms selected on			
Market value	27.6	28.5	27.3
Institutions	28.2	28.0	28.2
Transactions[a]	32.9	32.4	33.2
Transactions[b]	33.2	[c]	[c]

[a] The control portfolio selected in a manner identical to the market value and institutional holding samples.

[b] The control portfolio selected so that each option firm in the sample has fewer transactions than the associated nonoption firm.

[c] We did not compute individual year frequencies due to the rather small sample sizes ($N = 41$ and $N = 57$).

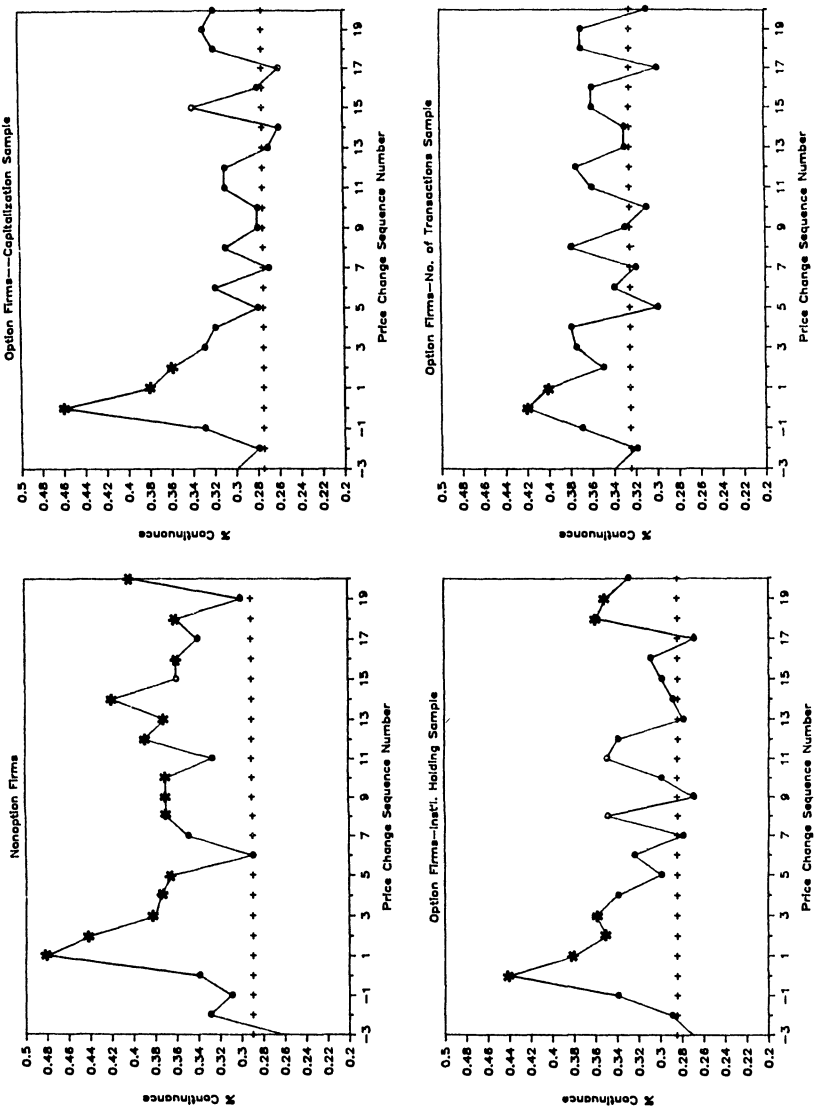


Figure 2. Relative Frequency of a Continuance (* = significantly elevated, $\alpha = 0.05$; O = significantly elevated, $\alpha = 0.10$)

period. The overnight price change (close to open) is treated as any other consecutive price change.[11] The nonannouncement period "normal" continuance frequencies are represented in Figure 2 as a horizontal line of crosses at the appropriate level.

The price adjustment processes for option and nonoption firms appear different. Option firms seem to have a process concentrated in the zero to +3 price change sequence number range. The nonoption firms' stock prices appear to adjust over a large number of price changes. All of the reported post-announcement price change sequence numbers for the nonoption firms exhibit elevated continuance frequencies compared to the 29% nonannouncement period norm. Fifteen of the twenty reported post-event frequencies are significantly elevated at the 10% level or beyond. Furthermore, while no completely logical argument can be advanced to explain why a particular price change sequence number's continuance rate is not significantly elevated, the nonoption firms exhibit a fairly consistently significant elevation through price change sequence number fifteen or sixteen. As aggregated χ^2 test for elevation of the relative frequency of a continuance for price change sequence numbers zero through twenty reveals that the nonoption firms are significantly elevated (at a 5% level). On the other hand, none of the option firm groups are significantly elevated from their Table III norms on a consistent basis past the third price change sequence number nor are they elevated on an aggregated basis. (The results for the alternative transaction sample are reported in subsection C of this section.)

Table IV reports the overall results in clock-time providing the continuance frequencies for each sample in the four 15-minute periods immediately following the announcement. The nonoption sample's frequency is elevated relative to the nonannouncement norm in all four of the 15-minute periods following the announcement, and significantly elevated in three. In contrast, for the option firm samples only the first 15-minute period is significantly elevated.[12,13]

[11] Without considering both days of the announcement period, sample sizes differ substantially due to the lower transaction frequency of the nonoption firms. For example, by price change sequence number +10 the sample sizes of the option firms are about 130 (out of 183) firms, while the nonoption firm sample size is 73. Since the distributions of release times during the announcement day are not substantially different, this modification of the PW methodology should not cause a bias in the results.

[12] Similar results are obtained in the two subperiods.

[13] An explanation for these results, other than differential price adjustment processes, is that the earnings releases of option firms are "less informative" than those of nonoption firms. If so, we should expect the option firms to exhibit a less pronounced price adjustment process. To investigate this possibility, we examined the change in annual earnings forecasts of the financial analysts reported in the SP *Earnings Forecaster* before and after interim earnings were announced. The argument is that substantial belief changes should be associated with "more informative" earnings announcements. We calculated the average percent change in the forecast of all analysts making a forecast before and after the announcement. (See Jennings and Starks [5] for a more detailed discussion.) The average change for the nonoption firms' earnings forecast was 3.9%. For the various samples of option firms, the average change ranged from 5.9 to 7.2%. Thus, option firms' earnings announcements appeared *more* informative on average, and should be associated with *more* pronounced price adjustment processes, ceteris paribus. This is inconsistent with our findings.

Table IV

Relative Frequency of a Continuance in the Hour After the Earnings Announcement ($N = 183$)

	Relative Frequency—Continuance			
Time Period (min)	Nonoption	Option—Size	Option—Institution	Option—Transactions
0–15	39.98**	42.59**	42.94**	50.03**
15–30	34.65	26.19	26.56	31.62
30–45	57.18**	24.86	24.94	30.82
45–60	35.58*	27.62	31.35	30.68
Nonannouncement norm	29.08	27.24	27.97	32.92

* Significantly elevated, $\alpha = 0.10$.

** Significantly elevated, $\alpha = 0.05$.

B. The Variance Test

Stochastic process tests examine the direction of stock price movement upon the earnings releases. To determine the effect of such announcements on stock price change variability, we employ the PW variance test. As with the stochastic process test, we infer the speed of price adjustment by observing the time required for the price behavior to return to its nonannouncement period norm. In this case, we determine the time over which the relative frequency of "extreme" price changes remains elevated. To qualify as large, an announcement period hourly (or overnight) price change must lie in either of the extreme 5% tails of the nonannouncement period price change frequency distribution. Following the procedure in PW, we compile nonannouncement period distributions for each trading hour and for the overnight period of each firm. Thus, for the 1981 sample of 84 firms, we calculated 588 (84 firms times 7 trading periods[14]) price change distributions.

To compute the number of extreme changes associated with a given announcement, we first identify the hour of the release. The price change in each trading period (hourly or overnight) is numbered relative to this "time zero" and called "extreme" if it falls in one of the 5% tails of the firm-specific nonannouncement period price change distribution. The number of extreme price changes is aggregated across firms for each relative trading period. Figure 3 summarizes our findings.[15] The vertical axis measures the actual number of extreme price changes relative to the expected number. Examining Figure 3 produces conclusions similar to those from the stochastic process tests. The number of extreme changes for nonoption firms is consistently elevated from the period prior to the earnings announcement until the ninth period subsequent. However, the majority of the consistent volatility increases for the option firms are in periods zero through two. While more significantly elevated observations for the option firms appear

[14] Six trading hours and one overnight price change.

[15] We present only the overall period results. Individual years' results are similar to the overall findings.

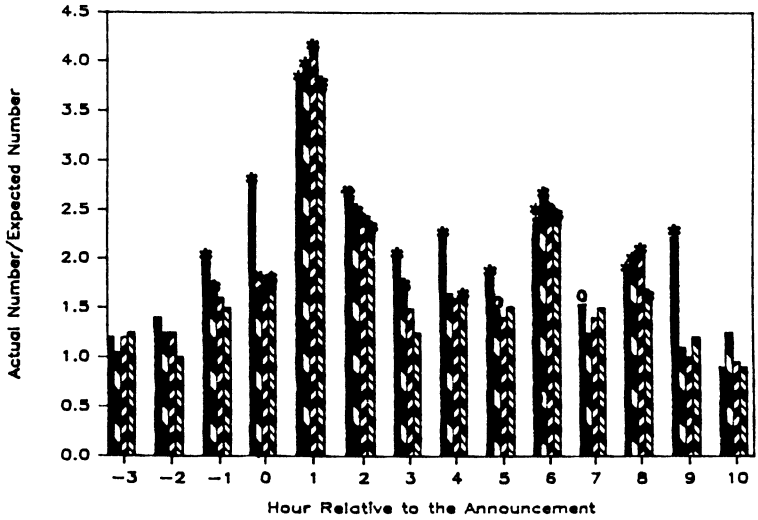


Figure 3. Extreme Price Changes (▬ = nonoption firms; ▭ = option firms—capitalization sample; ▭ = option firms—institutional holding sample; ▭ = option firms—number of transactions sample; * = significantly elevated, $\alpha = 0.05$; O = significantly elevated, $\alpha = 0.10$)

during the fourth to eigth periods than expected by chance, none of these portfolios exhibit the same consistency as the nonoption firms exhibit.[16]

C. Control Group Methodology

As discussed previously, we employed a second procedure to control for differences in transaction frequency between the option and nonoption samples. This second procedure guaranteed a nonoption sample with more transactions than the option sample. Overall, results from the three tests (transaction-time and clock-time stochastic process, and variance) are similar to the findings obtained using the other option samples. In the transaction-time stochastic process test, the alternative transaction option sample exhibited a significantly elevated continuance frequency at price change sequence numbers +3 (significant at the 1% level) and +4 (at the 10% level). None of the four 15-minute post-announcement intervals were significantly elevated at the 5% level in the clock-time tests. The variance test findings are nearly identical to the results reported in Figure 3. Significantly (5% level) greater than expected numbers of extreme price changes were found in periods zero, one, two, six, and eight.

Thus far, we have demonstrated a distinction between the stock price adjustment processes of option and nonoption firms even after attempting to control

[16] The stochastic process and variance tests were repeated using only firms having surprise information content to the earnings announcement. A firm was included in the surprise subsample if the mean annual earnings forecast (from the SP *Earnings Forecaster*) changed subsequent to the announcement. The results are very similar to the reported findings. The stochastic process test indicates a fairly consistent elevation in the relative frequencies of a continuance for nonoption firms past the tenth price change, while the option firms exhibit only sporadic elevation past the second. With the variance test, the nonoption firms seem to require nine periods to adjust, while the option firms appear to adjust in no more than six periods.

for factors other than option listing that might explain such a difference. We now reverse the procedure and examine the differences in these factors among our *option* firms. If the three characteristics provide some economic significance, and, if option firms divided along these characteristics differ substantially, then we would expect different price adjustment processes among option firms. On the other hand, if the subdivided option firms differ substantially in these characteristics, yet have similar stock price adjustment processes, the data are consistent with our claim that the stock price adjustment process is affected by options listing.

Accordingly, we divided the 150 option firms for 1981 and the 180 for 1982 into two groups along each characteristic. A "large" firm's characteristic was greater than the median and a "small" firm's characteristic was less than the median. Table V reports descriptive statistics for the capitalization, institutional holdings, and number of transactions for the "large" and "small" option firms. The "large" and "small" option firms differ more along each dimension than the option and nonoption samples differ (see Table II). Tests for differences in the medians of all three characteristics are significant beyond the 0.001 level for the "large" versus "small" option firm samples.

Figures 4A–C indicate that despite significant differences in large and small option firms' characteristics, the stock price adjustment processes differ little. The differences in price adjustment processes are considerably less than the differential between the samples of "control" option firms versus nonoption firms. This is consistent with the claim that the smaller difference in the option versus nonoption firms' characteristics is not totally responsible for the large difference in price adjustment between the option and nonoption firms.[17]

A factor besides investor interest/trading activity considered by option exchanges when examining listing candidates is the volatility of the firm's common stock return. Consequently, we examine the volatility of price by computing the price relative (p_{j+1}/p_j) for successive prices (regardless of whether the prices occur in the nonannouncement or announcement periods) and calculating the standard deviation of these price relatives. Table VI contains the descriptive statistics for our various samples. For each characteristic, we report the large and small option firm samples and the control option portfolios. The nonoption sample figures are at the bottom. Tests for differences in mean and median volatility were performed for the large versus small and option versus nonoption samples for each characteristic. The results indicate that the differences are significant beyond the 0.01 level for all six comparisons. In addition, the difference in large versus small option firm samples is relatively greater than the difference in the option versus the nonoption samples for each of the three attributes studied. This is consistent with our claim that the differences in price adjustment processes between option and nonoption firms noted previously are not due solely to differences in volatility between the option and nonoption firms since the large and small option samples differ in volatility yet exhibit almost no difference in price adjustment processes.

[17] Clock-time stochastic processes tests and variance tests between "large" and "small" option firms also support this claim.

Table V

Summary of the Sample Firms' Characteristics

Characteristic/Sample	Minimum	Tenth Percentile	Median	Ninetieth Percentile	Maximum	Mean
1981 ($N = 75$)						
Market value*						
Large	$1,585	$1,819	$3,113	$11,122	$47,750	$5,289
Small	$ 20	$ 330	$ 815	$ 1,398	$ 1,504	$ 849
Institutions holding						
Large	267	279	394	715	1,532	476
Small	1	68	150	240	266	151
Transactions						
Large	2,544	2,736	3,937	7,463	17,974	4,888
Small	402	920	1,791	2,373	2,492	1,692
1982 ($N = 90$)						
Market value*						
Large	$1,240	$1,397	$2,810	$10,310	$57,794	$4,088
Small	$ 52	$ 204	$ 614	1,085	1,221	639
Institutions holding						
Large	195	210	333	616	1,563	400
Small	14	61	119	178	195	118
Transactions						
Large	5,009	5,334	8,533	14,540	38,406	9,661
Small	1,096	1,753	3,352	4,707	4,942	3,323

* In millions.

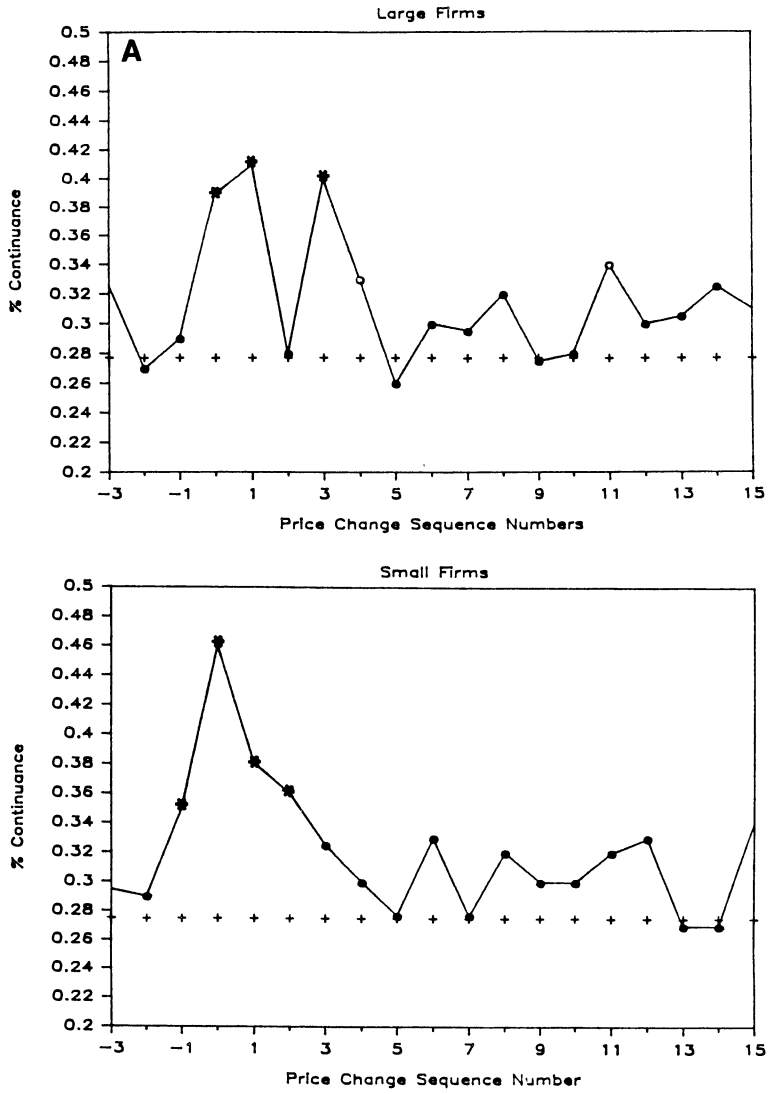


Figure 4A. Stochastic Process Test Results—Capitalization Sample (* = significantly elevated, $\alpha = 0.05$; ○ = significantly elevated, $\alpha = 0.10$)

IV. Conclusions

This study's findings are consistent with the hypothesis that the common stock of firms with exchange-listed options is associated with a different price adjustment process than that of nonoption firms. This hypothesis is suggested by Manaster and Rendleman when they posit that option markets may provide a preferred outlet for informed investors. We find that the stock prices of nonoption firms take longer to adjust to earnings announcements than the prices of control

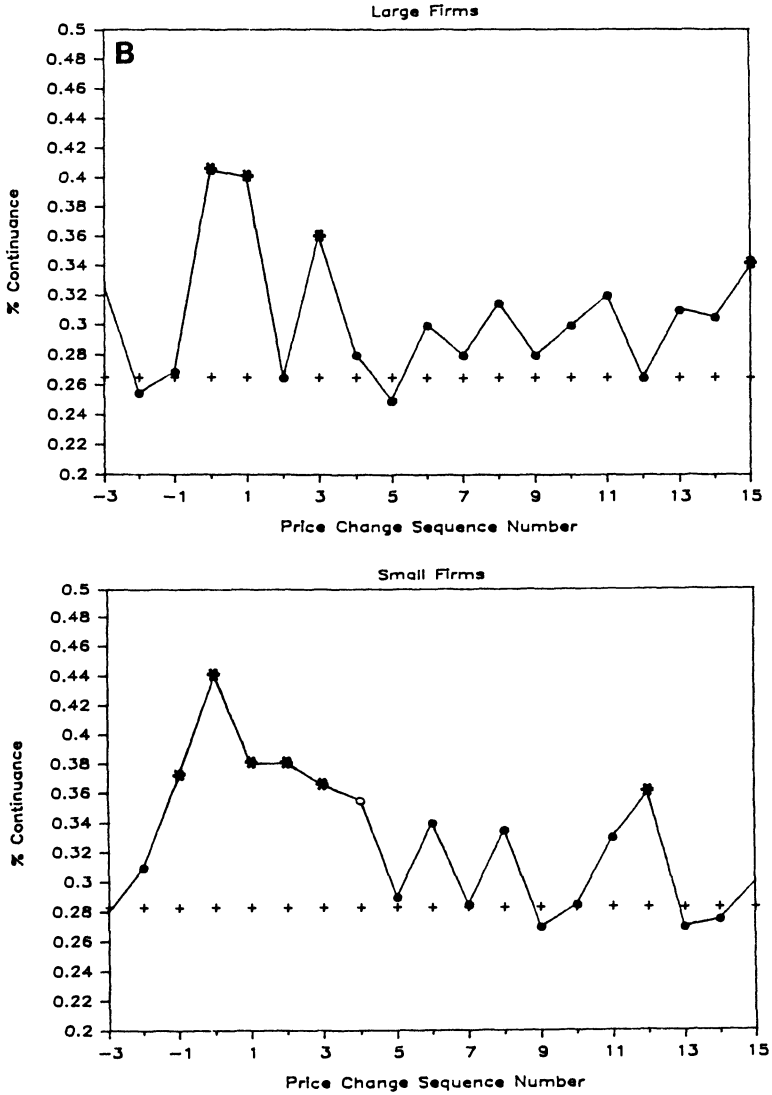


Figure 4B. Stochastic Process Test Results—Institutional Holding Sample (* = significantly elevated, $\alpha = 0.05$; O = significantly elevated, $\alpha = 0.10$)

portfolios of option firms. This supports the argument that the existence of the option market is useful in disseminating earnings news.

This paper represents a departure from previous studies examining effects of option trading on the secondary equity market. Extant research has focused on stock price behavior in periods of time separated by option listing or option expiration and seem to assume that, if behavior is affected, it is adversely affected. Our evidence appears to refute this fatalistic point of view.

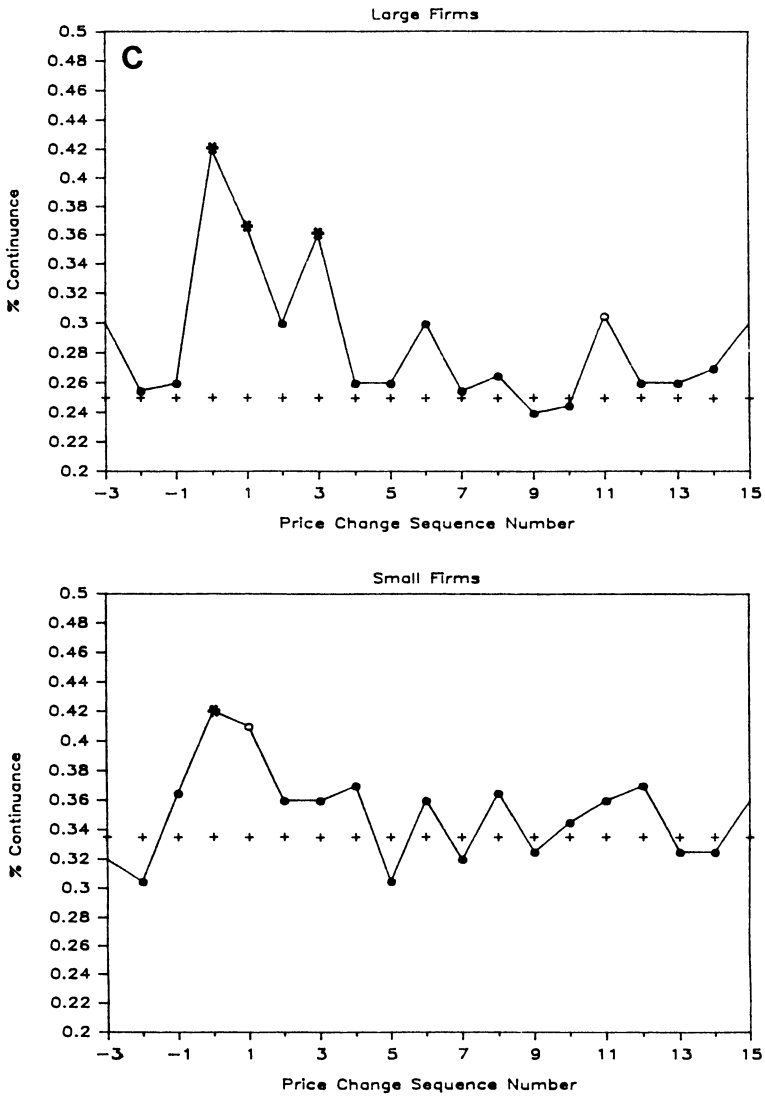


Figure 4C. Stochastic Process Test Results—Number of Transactions Sample (* = significantly elevated, $\alpha = 0.05$; O = significantly elevated, $\alpha = 0.10$)

MR hypothesize that option markets make stock market pricing more efficient. We find this conjecture is supported by the data. Other hypothesized benefits to contingent claims revolve around such issues as information transfer, risk reduction, and market completeness. Future research in this area should concentrate on developing testable hypotheses related to each of these claimed benefits. In this manner, the benefits of option trading can be more precisely defined.

Table VI

Descriptive Statistics of Price Relative Volatility

Characteristic/Sample	Minimum	Tenth Percentile	Median	Ninetieth Percentile	Maximum	Mean
Capitalization						
Large option	0.0076	0.0098	0.0162	0.0258	1.1327	0.0332
Small option	0.0089	0.0128	0.0203	0.0312	0.5224	0.0265
Control option	0.0089	0.0127	0.0203	0.0306	0.5224	0.0260
Institutions holding						
Large option	0.0076	0.0097	0.0161	0.0246	1.1327	0.0327
Small option	0.0101	0.0134	0.0207	0.0315	0.5224	0.0270
Control option	0.0089	0.0133	0.0206	0.0310	0.5224	0.0263
Transactions						
Large option	0.0076	0.0097	0.0143	0.0196	0.5224	0.0279
Small option	0.0149	0.0165	0.0219	0.0328	1.1327	0.0322
Control option	0.0142	0.0164	0.0218	0.0314	1.1327	0.0306
Nonoption	0.0131	0.0174	0.0281	0.0473	0.2343	0.0316

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