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Option Listing and Stock Volatility

In the aftermath of the stock market crash in October 1987, questions have been raised about the destabilising influence of options and other derived securities on the underlying markets. One viewpoint, elucidated in STEIN (1987) and supported by some market participants, is that option markets attract speculators and noise traders into the underlying stocks, leading to higher volatility and increases in trading volume. A contrary viewpoint is that the introduction of options makes markets more efficient by offering investors the opportunity to create positions more closely tailored to their risk preferences and investment needs, and in so doing leads to lower volatility in the underlying stocks [1]. While the empirical evidence from early studies of the option markets is mixed and does not provide clear support for either of these hypotheses, the evidence in more recent studies is supportive of the hypothesis that the introduction of options reduces the observed return volatility of the underlying securities. CONRAD (1989), SKINNER (1988) and NABAR and PARK (1988) examine the effects of the actual listing [2] on stock return volatility and report a significant decline in variance [3] after the listing. This paper provides further support for their findings and examines possible reasons for the variance effect.

Section 1 of the paper is a description of the firms in the sample, and of the time periods used to estimate the pre-listing and post-listing moments of the stock's daily return distribution. For the overall sample, we find a statistically significant decline in the daily return variance after option listing. Section 2 develops two hypotheses that might explain this reduction in volatility:

(a) The process by which information about a firm is collected and disseminated changes as a result of the listing of options on its stock. In particular, we test the proposition that more information is produced after the option listing.
(b) The nature of trading in the stock changes as a result of option listing, i.e. there are shifts in trading motives, trading volume, bid-ask spreads and/or other market structure characteristics.

We find empirical support for both hypotheses. An examination of the pre-listing and post-listing periods leads us to conclude that more information is collected and disseminated to investors after the listing of options. We also report a reduction in noise in the price process after the listing of options which we attribute to a lower bid-ask spread, partially because of increased competition from market-makers on the option markets and partially because of increased interest from institutional investors.

1. The Effects of Option Listing on Return Processes

In this section we provide a description of the sample and the estimation procedures used in the study. We also discuss our findings on shifts in the variances of daily return distributions of stocks as a result of the listing of options.

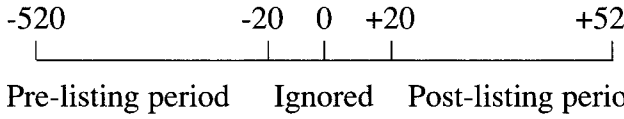
1.1. Sample Description

The sample consists of 200 stocks [4] which had options listed on them on between 1973-83 on two exchanges - 118 on the Chicago Board of Options Exchange (CBOE) and 82 on the American Stock Exchange (AMEX). The distribution of firms across the period is not uniform [5], with 130 firms having option listed on them between 1973 and 1976 and only 7 firms having options listed on them between 1977 and 1979. The option listing dates were obtained from the CBOE annual reports and the AMEX Fact Books. The Center for Research in Securities Prices (CRSP) daily returns tape is used to obtain daily returns for the stocks.

1.2. Methodology and Results

A. Daily Return Moments: Pre-listing and Post-listing

The return process moments are estimated using 500 daily returns preceding and following option listing. To eliminate any price effects associated with the actual listing, we eliminate the daily returns from the twenty trading days immediately preceding and immediately following the listing date:



The variance in returns is estimated for each firm in the sample for the pre-listing and post-listing periods first using raw returns and then using excess returns relative to the market model [6]. The parameters for the market model are estimated using the daily returns from 250 trading days preceding the pre- and post-listing periods, and the excess returns are defined to be:

$$ER_{it} = R_{it} - a - b\,R_{mt}$$

where,

ER_{it} = Excess returns for firm i on day t.
R_{it} = Raw returns for firm i on day t.
a,b = Market model parameters estimated using returns from day -770 to day -521 for the pre-listing period and from day -271 to day -20 for the post-listing period.
R_{mt} = Return on value-weighted New York Stock Exchange Composite.

Two tests are used to evaluate whether there are significant differences between pre-listing and post-listing return moments: a matched t-test [7] and a median test [8]. The t test assumes that the differences between pre-listing and post-listing variances are normally distributed, while the median test is a non-parametric test that requires only continuity in the distribution. In applying these statistics, we are aware of the problem arising from event clustering, with groups of firms sharing the same listing date. There are 200 firms in the sample but only 67 listing dates. To correct for the upward bias this induces in the statistics, we construct portfolios [9] of firms sharing the same event date and estimate the pre-listing and post-listing moments for each portfolio. Table 1 lists the cross-sectional averages of the variances of raw and excess returns before and after the listing of options for the individual firms in panel A and for the shared-event portfolios in panel B. It also reports the matched-pair and median t statistics. The variance in daily returns is about 20% lower after the listing of options on stocks using either the raw return or excess return measures. The drop is large for stocks listed on both exchanges and is statistically significant using either the t or median statistics for both the individual firms and for

Table 1: Return Process Variances Before and After Option Listing (Raw Returns and Excess Returns).

	Raw Returns					Excess Returns				
Variable	Before	After	T stat	% Increase	$\chi 2$	Before	After	T stat	% Incr.	$\chi 2$
Panel A: Individual Firms										
CBOE stocks(118)	0.000572 (0.00003)	0.000478 (0.00003)	-2.21	42.50%*	2.68	0.000410 (0.00003)	0.000345 (0.00003)	-2.09	39.46%**	2.52
AMEX stocks (82)	0.000696 (0.00004)	0.000468 (0.00004)	-7.17	13.58%**	7.87**	0.000507 (0.00003)	0.000352 (0.00003)	-5.78	12.66%**	7.39**
ALL (200)	0.000622 (0.00003)	0.000474 (0.00002)	-5.17	30.85%**	4.10**	0.000449 (0.00002)	0.000348 (0.00002)	-4.63	28.79%**	3.91*
Panel B: Shared-Event Portfolios										
Portfolio statistics (67 portfol.)	0.000452 (0.00004)	0.000356 (0.00004)	-2.33	28.57%**	4.74**	0.000347 (0.00004)	0.000273 (0.00004)	-2.49	34.92%**	2.87

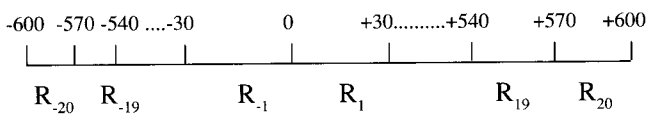
Notes:
* Significant at 5% level.
** Significant at 1% level.

Return variances are estimated using 500 days of returns before and after listing. The change is the cross-sectional average of changes in return variances.
T statistic = Cross-sectional average of changes / Cross-sectional standard error of changes.
% Increase = % of firms with higher post-listing variances than pre-listing variances. (** Significantly different from 50 %).
Excess returns are estimated using alphas and betas estimated from 250 trading days prior to the pre-listing and post-listing periods. The value-weighted NYSE index is used as the market index.
Layard's chi-squared statistics corrects for potential nonnormalities by examinings log(Variance) and sample kurtosis. It follows a $\chi 2$ distribution. (If this statistic is greater than 3.84 it is significant at the 5 % level).

the portfolios. To illustrate the pervasive nature of this effect, note that the variance estimates are lower after option listing for slightly more than 70% of the overall sample and almost 87% of the firms listed on the AMEX. Furthermore, the decline in variance is significant for listings in every year of our sample period.

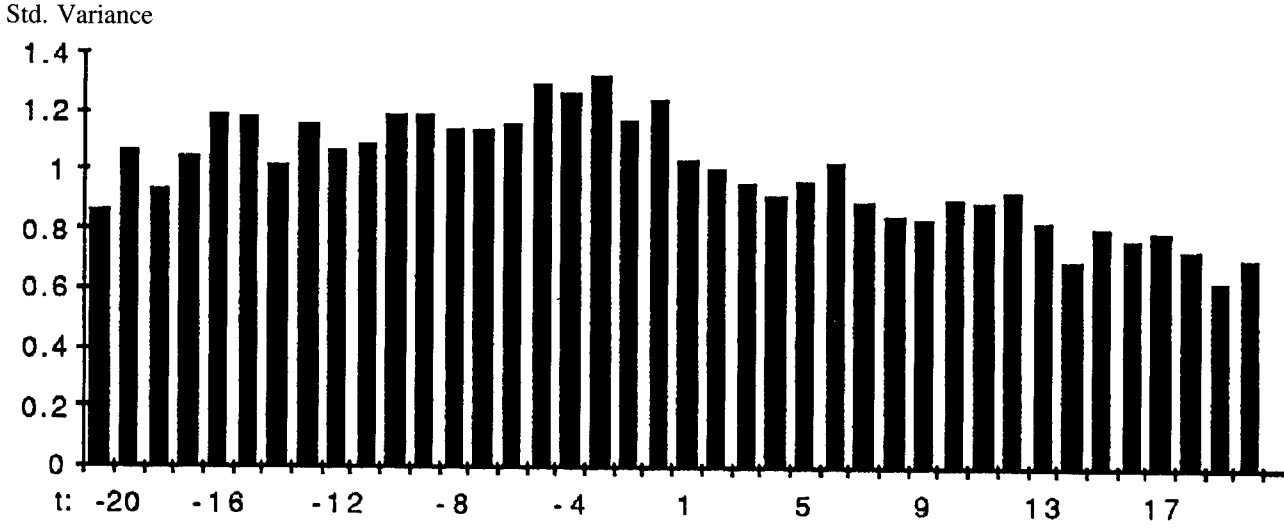
B. Short Period Moments

To evaluate the immediate effect of option listing, we estimate forty return process variances, using thirty daily returns for each estimation, starting 600 days before and ending 600 days after the listing. Defining day 0 to be the listing date,



To standardize variances, we calculate the ratio of each interval's variance to the average variance over all forty intervals. Figure 1 graphs the behavior of the cross-sectional averages of the standardized

Figure 1: Standardised Variance Before and After Option Listing. Twenty Intervals Before (-20,...,-1) and Twenty Intevals After (1,...,20).



Note:
Std. Variance (j) = Variance (j) / Average Variance over period.

variances over the sample period. Table 2 reports the t statistics [10] for whether the variance estimate in each interval is significantly different from the average for the period. Note that the variances before the listing date are significantly higher than the average, whereas those after the listing date are significantly lower than average. Note also that the variance decline is visible by the third return interval after listing (which is 90 trading days after the listing date). It gets progressively more significant in the intervals that follow. The results here provide further support for the finding that return variances decline after options are listed on a stock.

In summary, the listing of options on stocks has the immediate effect of reducing daily return variances. This drop in volatility is not caused by outliers or market trends, but is a direct result of the listing of options on the stock. The next section attempts to examine the source of this decline in volatility.

2. Explanations for Return Process Shifts

In section 1, we presented strong empirical support for the proposition that the return variances of stocks decline as a result of the listing of options on them. In this section, we consider two potential explanations for the decline in return variance after option listing:

Table 2: T-Statistics for Differences in Variances.

Interval	T-Statistic	Interval	T-Statistic	Interval	T-Statistic
-10	3.25	1	1.49	11	- 2.88
- 9	3.57	2	0.39	12	- 0.96
- 8	2.12	3	-0.83	13	- 2.73
- 7	2.32	4	-1.63	14	- 6.48
- 6	2.82	5	-0.64	15	- 4.59
- 5	3.84	6	-0.15	16	- 6.28
- 4	4.45	7	-2.50	17	- 4.45
- 3	5.33	8	-3.93	18	- 6.15
- 2	4.10	9	-3.57	19	-14.34
- 1	4.71	10	-2.27	20	- 7.64

Notes:
Variance change = Variance (t) - average variance over period.
The average variance over all forty intervals is first estimated. The difference between variance in interval t and the average variance is estimated for each firm.
The t statistics are estimated using the cross-sectional averages of differences in variance and cross-sectional standard deviations.

(a) More and better information may be produced on stocks after options are listed on them, leading to more efficient and less volatile price processes.
(b) The introduction of options may lead to lower bid-ask spreads on the underlying stocks, which in turn would explain the observed reduction in variance.

In the first part of this section, we examine proxies for information collection in the pre-listing and post-listing periods and find evidence that there is more information collected and disseminated to financial markets after options are listed on the stock. In the second part of this section, we report on the bid-ask spread in the pre-listing and post-listing periods, and again find evidence of a decline in the spread after the option listing. We attribute this decline to increased trading on the part of institutional investors after option listing.

2.1. Information Shifts after Option Listing

There are at least two reasons to believe that the introduction of options changes the incentives for information collection and, in the process changes the information structure. First, option markets offer informed investors and insiders an alternative and more leveraged approach [11] to exploiting their information advantages. Second, short selling restrictions that might prevent informed investors from exploiting negative information in the stock market are effectively undercut by the existence of option markets. To evaluate the effects of option listing on information structure we report the cross-sectional averages for two proxies for information collection during the pre-listing and post-listing periods:

(a) Number of analysts following the stock [12]: This statistic is obtained from the Nelson Directory of Investment Research for the year before and the year after the listing of options. This data was available only for firms listed after 1977.
(b) Number of Wall Street Journal articles on the firm: This statistic is obtained from the Wall Street Journal Index for each year for four years before, the year of and the four years after the option listing for each firm in our sample.

To provide a benchmark, we created a holdout sample which consists of firms which are in the same industry (COMPUSTAT SIC code) as the listed firms and were closest in market value to them in the year of the listing, and collected data on analysts and Wall Street Journal articles on these firms as well.

If the listing of options on stocks alters the dimensions of information structure, we would expect to see changes in these proxies as well. Table 3 summarizes the averages for these proxies in the pre-listing and post-listing periods for the firms in our sample and those in the holdout group.

Three interesting findings emerge from this analysis. First, there are marginally larger increases in the number of analysts and significantly larger increases in the number of Wall Street Journal articles for the firms which had options listed on them than for the holdout sample. Second, firms that had options listed on the CBOE had a much larger following in terms of analysts and journal articles, prior to listing, than those that had options listed on the AMEX. Third, the post-listing increase in both proxies is larger in percentage terms for firms which had options listed on them on the AMEX than for the larger and more-followed firms on the CBOE.

The increase in information after option listing that we note in this table, especially for AMEX stocks, has some interesting implications. First, it suggests that as options get listed on the smaller, less-followed stocks, we should expect to observe an increase in the amount of information that is collected and disseminated to financial markets on these firms. Second, the increased following that optioned stocks attract may explain why prices adjust much more quickly [13] to information after listing. Given this evidence, it seems likely that some of the decline in return volatility after listing can be explained by

Table 3: Information Proxies Before and After Option Listing (Number of analysts and WSJ articles).

Information Proxy	CBOE Listings		AMEX Listings		All Listings		Holdout Sample	
Number of Analysts	Mean	Std Error	Mean	Std Error	Mean	Std Error	Mean	Std Error
Before option listing	15.024	1.077	11.512	0.972	13.326	0.703	7.2809	0.856
After option listing	17.366	1.087	14.091	0.961	15.839	0.733	8.3933	1.051
Change	2.341	0.487	2.721	0.481	2.605	0.339	1.1124	0.372
T-statistic for change	4.81		5.65		7.68		2.99	
% of firms higher	74.42%**		72.09%**		73.26%**		48.31%	
Number of WSJ Articles								
Before option listing	36.075	3.536	29.059	1.848	33.098	2.225	29.688	1.753
After option listing	44.026	4.013	34.545	2.474	40.164	2.628	29.091	1.924
Change	6.728	1.174	5.462	1.148	6.215	0.834	-0.598	0.751
T-statistic for change	5.73		4.76		7.45		-0.80	
% of firms higher	70.40%**		67.95%**		69.90%**		40.20%	

Notes:
** Significant at 1% level.
The holdout sample consists of firms which are in the same SIC code as the listed firms and are closest in market value in listing year.
Number of analysts for the year before and the year after listing are from the Nelson Directory of Securities Research. This data was available only for 85 firms listed after 1979. The sample size is 85 firms for the number of analysts (41 on CBOE and 44 on AMEX).
Number of Wall Street Journal articles for the four years before and after listing are obtained from the WSJ Index. The cross-sectional averages of the number of articles in the pre- and post-listing periods are reported.
The "change" is the cross-sectional average of changes in information proxies.
T-statistic = Cross-sectional average of changes / Cross-sectional std error of changes.
% of firms higher = % of firms with post-listing proxy measure higher than pre-listing measure. (** Different from 50%).

shifts in information structure. It is also clear that these movements in the information structure are not of sufficient magnitude to explain all of the dramatic decline we observe in the variance.

2.2. Shifts in the Noise Term: The Effects of the Bid-Ask Spread

The effects of the bid-ask spread on return process characteristics have been debated widely in the literature. ROLL (1984) shows that, in an efficient market, bid-ask spreads induce negative serial correlation in observed market price changes. Ceterus paribus, the higher the bid-ask spread, the higher is the noise term in observed return variance. In an empirical examination, FEDENIA and GRAMMATIKOS (1989) report an option listing effect on bid-ask spreads [14], with highly liquid stocks having spread increases and illiquid stocks having spread decreases.

To evaluate the effect of option listing on the noise term in observed return variance and on the bid-ask spread, we report on the following proxies:

Proxy for noise = Variance in daily returns/ Variance in twenty-day returns

Proxy for the bid-ask spread = $2\sqrt{-Cov}$

where Cov is the covariance in five-day returns [15]. The variance ratio has been suggested as a measure of noise by DAMODARAN (1985) and by FRENCH and ROLL (1986), while the serial covariance measure of the bid-ask spread has been suggested and tested by ROLL (1984). Table 4 summarizes these statistics for the pre-listing and post-listing periods.

While both the variance ratio and the covariance measure of the spread decline significantly for stocks that were listed on the AMEX, stocks listed on the CBOE register much smaller reductions in the proxies for the noise and spread terms. This evidence is consistent with differences noted between stocks listed on the two exchanges in information production after option listing in Table 3, and suggests that the benefits from option listing are greatest for smaller stocks.

TINIC (1972), BENSTON and HAGERMAN (1974) and STOLL (1978) examine the determinants of the bid-ask spread and conclude that the spread is lower, the greater the competition among market makers and the higher the measure of trading activity (measured by trading volume or institutional shareholding). NEAL (1987) notes that the spreads on multiple listed options are significantly lower than those on single-listed options, even when there is a high concentration of trading volume on a single exchange. Since market makers on the option mar-

Table 4: Noise and Spread Proxies Before and After Option Listing.

Information Proxy	CBOE Listings		AMEX Listings		All Listings	
Variance Ratio	**Mean**	**Std Error**	**Mean**	**Std Error**	**Mean**	**Std Error**
Before option listing	1.1228	0.0403	1.4044	0.0868	1.2366	0.0435
After option listing	1.0296	0.0376	1.1414	0.0482	1.0748	0.0298
Change	-0.0932	0.0553	-0.2629	0.0875	-0.1618	0.0486
T-statistic for change	-1.68		-3.01		-3.33	
% of firms higher	40.68%**		35.00%**		38.38%**	
Bid-Ask Spread						
Before option listing	0.0302	0.00185	0.0349	0.0027	0.0322	0.0016
After option listing	0.0262	0.00173	0.0288	0.0019	0.0273	0.0013
Change	-0.0065	0.00241	-0.0061	0.0028	-0.0049	0.0018
T-statistic for change	-1.67		-2.23		-2.71	
% of firms higher	47.37%		45.00%		46.39%	

Notes:
** Significant at 1% level.
Variance Ratio = Variance in daily returns / Variance in monthly return. This is a measure of the noise in the price process.
Bid-Ask Spread = - $\sqrt{2}$(Covariance in five-day returns).
The "change" is the cross-sectional average of changes in information proxies.
T-statistic = Cross-sectional average of changes / Cross-sectional std error of changes.
% of firms higher = % of firms with post-listing proxy measure higher than pre-listing measure. (** Different from 50%).

kets offer at least partial competition for specialists on the underlying stock, one can argue that the introduction of options will reduce spreads.
To evaluate whether option listing affects the trading activity variables, we collect and report the pre-listing and post-listing statistics on two variables:

(a) Weekly trading volume data for each firm in the sample for the twenty six weeks before and fifty two after the listing of options from the S&P Daily Stock Price records.
(b) Institutional holding [16] as a percentage of outstanding stock for the three quarters before, the quarter of and the three quarters after the option listing, obtained from the Moody's handbook of common stocks.

To adjust for changes in overall market trading, we collect data on total volume on the New York Stock Exchange (NYSE) for each week and estimate the market-adjusted trading volume using the market volume in week -26 as the base week (week 0 is the listing week):

$$\text{Market-adjusted Volume}_{it} = \text{Volume}_{it}/(\text{Volume}_{mt}/\text{Volume}_{m,-26})$$

where,
Volume_{it} = Trading volume on firm i in week t
Volume_{mt} = Total trading volume on New York Stock Exchange in week t.

To explore the relationship between option listing and weekly trading volumes further, we estimate the average weekly trading volume over thirteen-week periods starting twenty six weeks before listing and continuing through fifty two weeks after listing and report them in Table 5. We also estimate changes in average trading volume for each of the four post-listing periods:

$$\text{VOLCH}_t = \text{VOLA}_t - \text{VOLB}$$

where,
VOLCH_t = Change in average weekly trading volume in period t
VOLA_t = Average weekly trading volume in post-listing period t
VOLB = Average weekly trading volume in period immediately preceding listing.

The t and median statistics are estimated and reported for these volume changes in panel A of Table 5 for the total volume and panel B for market-adjusted volume.
The evidence on trading activity is mixed. While total trading volume increases marginally in the twenty six weeks immediately following the listing, the market-adjusted trading volume decreases marginally in the first thirteen weeks after listing, decreases significantly in the following thirteen weeks and increases again to pre-listing levels over the final two post-listing periods [17]. In contrast, the institutional holding, reported in panel C of Table 5, increases dramatically after the option listing, with the percentage holding increasing from 19.39% in the quarter before the listing to 32.56% after the listing. Increased institutional interest [18] has been associated with lower bid-ask spreads for two reasons. First, the spread is generally a decreasing function of the size of the trade and institutions trade in larger quantities than individuals do. Second, institutions are much more likely to take their trades to other markets (the third market or the option market) if they can get lower transaction costs from market-makers in those markets. This increases the competitive pressures on market-makers on the underlying stock, especially after the opening of option markets.

3. Implications

These findings have broad implications for both regulators and practitioners. First, there is clear evidence in this paper that listed option markets do not increase volatility. On the contrary, the introduction of options seems to have the beneficial effects of increasing information availability and reducing bid-ask spreads on the underlying stocks. While we are reluctant to extend this argument to

Table 5: Trading Activity Variables Before and After Option Listing.

Trading Volume	Average		Change From Pre-Listing Average			
	Mean	Std Error	Mean	Std Error	T-Statistic	% Higher
Total Trading Volume						
Week: -26 to -14	2339.91	109.98	-	-	-	-
Week: -13 to - 1	2551.85	131.56	-	-	-	-
Week: 1 to 13	2736.23	142.49	184.38	98.02	1.88	55.89%
Week: 14 to 26	2687.17	130.18	135.32	104.63	1.29	52.84%
Week: 27 to 39	2932.83	132.51	380.98	120.32	3.17	63.76%**
Week: 40 to 52	2748.57	126.96	196.71	122.16	1.61	61.13%**
Market-Adjusted Trading Volume						
Week: -26 to -14	2221.18	105.02	-	-	-	-
Week: -13 to - 1	2328.74	126.67	-	-	-	-
Week: 1 to 13	2312.58	117.81	- 16.16	85.40	-0.19	46.84%
Week: 14 to 26	2086.32	92.22	-242.42	92.41	-2.62	38.39%**
Week: 27 to 39	2334.60	109.71	5.85	105.19	0.06	48.95%
Week: 40 to 52	2184.64	106.89	-144.11	105.56	-1.37	41.77%**
Institutional Holding (as % of shares outstanding)						
Quarter: - 3	16.86%	0.99%	-	-	-	-
Quarter: - 2	17.36%	0.96%	-	-	-	-
Quarter: - 1	19.39%	1.05%	-	-	-	-
Quarter of Listing	20.99%	1.15%	3.12%	0.58%	5.39	66.84%**
Quarter: +1	23.14%	1.24%	5.27%	0.73%	7.20	70.00%**
Quarter: +2	29.89%	1.22%	12.02%	0.91%	13.25	85.79%**
Quarter: +3	32.56%	1.25%	14.69%	1.13%	13.04	87.89%**

Notes:
** Significant at 1 % level.
Trading volume is number of shares traded.
The weekly trading volume data is obtained from the S&P Daily Stock Price records and the institutional holdings from Moody's.
The market trading volume in week -52 is used as the base week for calculating the market adjusted volume.
Market adusted trading volume = Volume for firm j in week t / (Market Volume in week t / Market Volume in week -52).
Change from pre-listing = Average Weekly Volume in post-listing period - Average Weekly Trading Volume in weeks -13 to -1. For the instituional data it is relative to the average in the 3 quarters prior to the listing.
T-statistic = Cross-sectional average of changes / Cross-sectional std error of changes.
% of firms higher = % of firms with post-listing volume higher than pre-listing volume. (To evaluate wheter this fraction (p) is significantly different from 50%, we use a T-stat = $(p - 0.5)/(0.5 / \sqrt{n})$.

stock-index option and stock-index futures, these findings still have relevance for those regulators who are examining whether curbs should be put on trading on these derived securities in the aftermath of the market crash of 1987.

Second, the decline in stock price volatility associated with option listing raises some interesting questions about the use of variances derived from past price data, especially as inputs in the Black-Scholes model for valuing options. In the period immediately after option listing, the use of these historical variances will, on average, yield model prices that are much too high (relative to true value). If option prices do not reflect the decline in stock price

variance, (i.e. market participants continue to use historical variances to price options) there might be profit opportunities available for prescient investors during the transition period.

Third, option strategies that are based upon slow price adjustment processes may have to be reevaluated in light of the fact that more information is produced and disseminated after options are listed. This increased information production will, in general, increase the speed of the price adjustment process and lower potential profits from such strategies. To illustrate, consider a market where stock prices react slowly to the news in earnings announcements [19]. When options are introduced in this market, a simple strategy to take advantage of the slow price adjustment process would be to buy calls (puts) immediately after positive (negative) announcements. While this strategy might have made profits under the old information regime (before option listing), it might no longer do so in the new information regime (after option listing), where more information is being collected and utilized by investors and prices adjust much more quickly to news announcements [20].

Fourth, the increase in institutional interest in the stocks which have options listed on them is a significant for several reasons. It suggests that institutional investors find the investment flexibility that options offer (in terms of hedging risk or augmenting returns) desirable, and that they are likely to be active players in both the option and the stock markets. While this may have the positive effect of increasing liquidity and reducing transactions costs in both markets, there may be negative implications as well since studies that report a negative correlation between institutional holdings and average returns on stocks [21].

Finally, this paper illustrates the importance of both market-structure and information characteristics in determining stock price volatility and any event that affects either or both will also change the variance of a stock and consequently, the prices of options listed on it. While we have focused on option listing in this paper, it is only one of a broader list of such events, a partial list of which would include listing on a more liquid exchange [22] (eg. switching from trading over-the-counter market to the NYSE), dual listing (eg. listing a U.S. stock on the Tokyo stock exchange) and institutional changes to market structure (eg. the Big Bang on the London stock exchange).

4. Conclusion

The returns processes of stocks change after the listing of options on them. Examining the daily returns of the 200 stocks in our sample in the two years immediately preceding and following the option listing date, we find a significant decline in return variances. These findings are confirmed by examining return moments over thirty-day intervals and are not the consequence of outliers or market trends.

Empirical examinations of information structure proxies reveal an increase in the amount of information and a decrease in the noise in price processes after option listing, especially for the firms with options listed on the AMEX. We attribute the decline in the noise term to a lower bid-ask spread after listing, partially because of increased competition from market-makers on the option market and partially because of increased institutional activity in the stock.

Footnotes

[1] Two arguments are generally used to establish this linkage. The first is that risk-averse investors, using options to hedge their stock positions, will be less likely to be involved in panic selling. A second argument is that option markets improve the quality of information available to financial markets and thus reduce deviations from true value.

[2] There is some evidence in CONRAD that the option listing has a price impact, suggesting that there might be a residual informational effect associated with it.

[3] They use a wide range of techniques to arrive at this conclusion. CONRAD uses 200 trading days before and after listing to compute pre-listing and post-listing variances, while SKINNER uses 500 trading days for each. NABAR and PARK use an event-study approach and compute variances in thirty-day return periods before and after listing.

[4] We include all firms which had options listed on the CBOE and AMEX, and which also had daily returns data available on the CRSP daily returns tape for 500 trading days before and after the option listing. Consequently our sample size is much smaller than that in NABAR and PARK (who have 390 listings).

[5] The SEC imposed a freeze on option listing between 1977 and 1980 while it reviewed the trading practices of the exchanges and the economic impact of option trading.

[6] We estimated excess returns using two different approaches. The first estimate was obtained by subtracting out returns on the NYSE index from the daily return for the firm being examined. The second estimate was obtained by first estimating market model parameters (alphas and betas) from a prior time period, and then using these alphas and betas to estimate conditional expected returns in the period being examined. The two approaches give very similar results. The reported results use the second approach.

[7] Matched t-test: This corresponds to a test of differences in two means with paired samples:

$$T_{par} = \Delta(j)_{ba}/s_j$$

where,

$\Delta(j)_{ba}$ = Cross-sectional average of differences between pre-listing and post-listing estimates of the j'th moment.

s_j = Cross-sectional standard deviation of differences between pre-listing and post-listing estimates of the j'th moment.

[8] With large samples, the actual number of firms with higher pre-listing moments can be compared to the expected number to arrive at a t statistic:

$$T_{med} = (\Delta(j)_+ - 5\,n) / (0.5\sqrt{n})$$

where,

$\Delta(j)_+$ = Number of firms with post-listing j'th moment > pre-listing j'th moment.

n = Number of firms in sample.

[9] There are clear limitations to the approach used in this section to examine volatility before and after option listing. Even with the shared-event portfolios, there is substantial overlap in returns across portfolios because two years of data are used for estimating the variances in the pre-listing and post-listing periods. We will attempt to correct for this problem in the two tests that follow.

[10] F statistics were also estimated for the variance ratio and they indicate significant declines in the estimated variance in the intervals after the option listing.

[11] While investors may be able to create positions of equivalent leverage using stock and borrowing, exchange restrictions on margin requirements may limit the leverage attainable with stock. For instance, an individual who possesses exceptionally good information may buy a deep out-of-the-money call option to take advantage of it. He may not be able to create an equivalent position with stock.

[12] Only sell-side analysts are listed in the Nelson Directory of Investment Research. This data is available for only 85 firms in the sample, listed since 1980.

[13] JENNINGS and STARK (1981) report that optioned stocks adjust much more quickly to new information in earnings announcements than non-optioned stocks.

[14] The spreads on NYSE stocks were obtained from the Fitch pink sheets, and for OTC stocks from the CRSP data base.

[15] We use five-day returns because they are much less likely to be contaminated by lagged price adjustment processes, which can lead to positive covariances.

[16] Institutional holding is defined by Moody's to be the holdings of domestic investment and insurance companies in the firm.

[17] By looking at the trading volume on the stock alone, we may be missing part of the volume effect. A more relevant measure of volume may be the combined volume on the stock and option markets.

[18] The increase in institutional interest may also help explain our findings on the information proxies. As institutional activity increases, more analysts follow the stock, leading to increased information production on the stock.

[19] Studies seem to indicate that positive (negative) earnings surprises elicit positive (negative) market responses. Furthermore, WOODRUFF and SENCHACK (1988) report that prices adjust much more slowly to negative than positive reports.

[20] DAMODARAN (1989) reports that prices adjust much more speedily to negative earnings announcements after puts are listed on the stock.

[21] EDELMAN and BAKER (1987) report that firms with less than 9 institutional owners make significantly higher returns than firms with more institutional ownership after adjusting for risk. Similar results are reported by ARBEL and STREBEL (1982).

[22] DAMODARAN (1989) reports that stocks that switch

from listing on the American Stock Exchange to the New York Stock Exchange have significantly more negative returns after the switch.

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