THE PRICE EFFECT OF OPTION INTRODUCTIONS: 1973-1992

By

SORIN SORESCU

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1996

To my wife Alina, living proof that Love is the only raison d'être.

To my parents Gabriela and Mihai whose courage and determination made all of this possible.

ACKNOWLEDGMENTS

This dissertation was inspired by initial conversations with Mark Flannery, David T. Brown and Jerome Detemple. I am truly indebted to Mark Flannery, who provided guidance, support and inspiration throughout the entire process. I also wish to express my sincere thanks to Mahendrarajah Nimalendran, Jonathan Hamilton, Andy Naranjo, and in particular to David T. Brown, for many excellent comments received on earlier versions.

This research was supported in part by a Doctoral Fellowship from the Social Sciences and Humanities Research Council of Canada, whose contribution is greatly appreciated.

TABLE OF CONTENTS

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
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By

Sorin Sorescu

August 1996

Chairman: Mark J. Flannery
Major Department: Finance, Insurance and Real Estate

I examine the effect of option listings on the price of underlying stocks for the period 1973-1992. In accordance with previous studies, I find that options increase stock prices during the 1973-1980 period. While some authors attribute this price effect to market completion, I show that it is more likely caused by option dealers manipulating underlying stock prices during that period.

Federal regulations introduced at the end of 1980 have eliminated many of the opportunities for manipulating stock prices during the 1981-1992 period. Accordingly, no evidence of price manipulation is found for that period. Surprisingly however, after manipulation ceases, the price effect of option introductions does not merely vanish, but becomes negative.

Two explanations are proposed for the occurrence of this negative effect after 1980: The first is the selection bias hypothesis, according to which exchanges would only

introduce options on stocks that have over-performed the market in the near past. If this hypothesis holds true, the negative price effect would therefore simply represent the return to a "more normal" stock performance after the option becomes listed.

The second is based on the premise that option listings reveal new information, which causes stock prices to adjust accordingly.

The data do not support either of these hypotheses, suggesting that the negative price effect of option introductions is consistent with equilibrium changes in stock prices. Understanding the cause of these equilibrium price changes remains an important issue for further research.

CHAPTER 1
INTRODUCTION

An increasingly important issue in the study of financial markets concerns the extent to which options interact with their underlying stocks. Although Black and Scholes (1973) view options as redundant securities, a growing number of empirical studies have established that stock prices are generally affected when traded options are first listed. Conrad (1989) shows that between 1974 and 1980, underlying stocks experienced positive abnormal returns around the date of their option listing, and concludes that "options are not entirely redundant" (p. 488)[1]. Skinner (1989) reinforces Conrad's conclusion by documenting a decline in stock volatility after listing.[2]

Several academic authors indicate that options' positive price impact and negative volatility effect enhance shareholder wealth and contribute to economic growth.[3] By contrast, the popular press has long suggested that options destabilize markets by encouraging speculative behavior. This concern was also shared by the Securities and Exchange Commission (SEC) in 1977, when it suspended the introduction of new stock

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[1] This evidence is also supported by Detemple and Jorion (1990), Kim and Young (1991), Branch and Finnerty (1981). An interesting (and puzzling) finding in both Conrad and Detemple and Jorion is that stock prices adjust only on the date of option introduction, not on the date of the listing announcement.

[2] See also Damodaran and Lim (1991), Bansal, Pruitt and Wei (1989), Conrad (1989).

[3] See, among others, Allen and Gale (1994), Branch and Finnerty (1981), Klemkosky and Maness (1980), Bansal, Pruitt and Wei (1989).

options and mandated a general study (the Options Study) to determine "whether standardized options trading represents a threat to the integrity of the capital raising function of the securities markets"[4] (SEC Release No. 30-14056).

Concerns about the negative effects of options surfaced in the legal arena in 1983, when Golden Nugget's stock price dropped 17.2% around the initial listing of its traded option.[5] Golden Nugget's management promptly sued the American Stock Exchange (on which the option had been listed), contending that options are "competing investment vehicles, that draw potential capital away from the company's issues of common stock."[6]

More recently, Netscape stock price dropped from \$75 to \$62 in the 10-day period surrounding the listing of its first option contract.

While the collapse in Netscape and Golden Nugget stock prices appear to contrast with the findings of Conrad, it is important to note that both cases occurred almost three years after the last year in Conrad's study period. It is therefore interesting to determine if these cases are a simple exception to Conrad's "rule," or whether they have become the "new rule" at some point after the end of Conrad's study period. In other words, how have stocks generally reacted to their option introduction after 1980?

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[4] Unfortunately, the question could not be answered, due to limited data availability at the time. (Exchange traded options had only existed in the US since 1973.) Instead, the study recommended a number of policy changes, aimed at preventing reported instances of stock price manipulation and unethical sale practices.

[5] Golden Nugget's call options were first listed on the American Stock Exchange on August 17, 1983. The price of the underlying stock dropped from \$16.00 to \$13.25 in the ten-day window surrounding the listing event.

[6] Quoted in Regulatory and Legal Developments, DER No. 215, P. A-4, November 4, 1983, emphasis added. The law suit was dismissed in 1986 on grounds that the company's stock belongs to its shareholders, and that the management is not entitled to sue on their behalf.

In Chapters 3, 4 and 5 of this dissertation I show that the positive price effect documented by Conrad (1989) is confined to the period prior to 1980, and is likely to result from option dealers manipulating underlying stock prices. After late 1980, when federal regulators limited the extent to which option dealers could trade in underlying stocks, the positive price effect becomes <u>negative</u>, and no further evidence of market manipulation is detected.

Chapter 6 investigates whether the post-1980, negative price effect of option introductions is caused by a bias in the exchange selection process, and presents evidence refuting this hypothesis.

Chapter 7 explores whether the price effect is a reflection of the private information available to informed traders at the time of listing, which would be revealed to the market as a consequence of these traders' migration from the primary to the derivative security. The chapter, however, presents evidence which is strongly inconsistent with this information hypothesis.

The overall results from Chapters 3 through 7 leave wide open the possibility that the observed negative price effect could in fact reflect a reduction in the demand for underlying stocks, produced by the listing of options. This hypothesis remains an important topic for further research.

The dissertation concludes with a summary and a brief description of this study's implications for regulators and researchers.

CHAPTER 2
REVIEW OF LITERATURE

Introduction

Empirical studies of the interaction between options and stocks are primarily concerned with documenting the effect of option listings on the price, volatility and bid/ask spread of underlying stocks. By contrast, theoretical studies address either (1) the ability of options to "complete" the markets, or (2) the effect of options upon the stock market information structure. With respect to the integration of theory and empirics into one, unified body of literature, Damodaran and Subrahmanyam (1992) write:

> Although the empirical hypotheses tested could be tied in with the theoretical developments, they appear to have evolved in separate directions. Hence, the empirical work has not been tied in with particular model structures, but devoted to testing more general hypotheses. (p. 17, emphasis added)

This chapter reviews a number of empirical and theoretical papers which are relevant to the present study, and points to specific instances where the literature would benefit from a better integration of theory and empirics.

Empirical Papers.

Branch and Finnerty (1981) provide the first study of the impact of option listings upon stock prices. They evaluate excess returns for a 12-week period around the announcement date, using a market model with betas obtained from Value Line.[1] They

[1] Their sample period extends from 1973 to 1977.

find positive excess returns in the second week following the announcement date, and conclude that options increase demand for underlying stocks. The authors interpret this post-announcement effect as " 'a thing of value' to the affected company" (p. 12).[2]

Conrad (1989) examines the effect of option listing on stock prices and volatilities, using all options introduced between 1974 and the end of 1980. She excludes the first options listed in 1973 in order to eliminate learning effects associated with these securities. She examines abnormal returns around both listing and announcement dates. She finds significant positive abnormal returns around listing dates, and no abnormal returns around announcement dates.[3] She concludes that (1) "options are not completely redundant securities" (page 488), (2) the observed price effect is due to an increase in the demand for stock caused by option dealers, and (3) the absence of an effect at announcement date is due to transaction costs: "the price effect may be sufficiently small (2%) that transaction costs make it unprofitable for any but those traders who anticipate acting as dealers in the new option and using the security to hedge" (page 488).

Detemple and Jorion (1990) also examine the effect of option introduction on stock prices for a sample of 300 stock options listed between April 1973 and December 1986. Since many of these options were listed simultaneously, their sample includes only

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[2] The presence of positive abnormal returns two weeks after the announcement date is also consistent with abnormal returns occurring around option listing.

[3] The absence of abnormal returns around the announcement date could be explained by the fact that the initial listing announcement is in fact only an "option" to list at that date. Conrad in fact observes that some options do not get listed on the day in which they were announced, but rather during a window of 125 trading days after the originally-announced date. Accordingly, to the extent that announcements convey noisy information, one should not expect to find any reaction in underlying stock prices on that date.

53 event dates. They, like Conrad find significant price increases (2%) around the listing date, and no price impact at announcement.

While the absence of an announcement price effect seems puzzling in an efficient market, Detemple and Jorion present two possible explanations for this idiosyncrasy. First, an announcement is only an option to introduce a contract on a given date. In their study, approximately one third of all option announcements did not materialize as scheduled. In some cases, the contracts have been listed more than one year behind schedule. Second, among the remaining two thirds of the sample for which the announcement materialized as scheduled, the listing date followed the announcement date by approximately one to two days, making it difficult to differentiate between listing and announcement effects.

The main contribution of the Detemple and Jorion study is to examine the effects of options on stocks other than the underlying one. In particular, they find that upon option listing, a portfolio of stocks belonging to the same industry as the underlying stock (but excluding that stock) also experiences an increase in its market value (1.5%). More surprisingly, they also find that the entire market experiences an increase in its value around listings of individual stock options (1.1%).

The authors also divide their sample period into three sub-samples, with June 1975 and March 1982 as cutoff dates. They find strong, positive abnormal returns in the first two sub-periods, and no significant abnormal returns in the last sub-period. The authors suggest that their results are consistent with options completing the markets: "Contrary to the premises of classic arbitrage pricing models, option markets have a real effect on equilibrium prices and allocations. We find evidence of significant price increases in the optioned stock around listing dates" (p. 800). Moreover, they explain the absence of positive abnormal returns after March 1982 by the fact that options on S&P 500 futures were introduced in April 1982:

> The price effect seems to be localized in the first two sample periods, and is much weaker in the 1982-1986 sub-period. Since options on stock indices have been introduced in 1982, these results are consistent with the numerical analysis in [a previous Detemple and Jorion working paper]: the price effect of a new option listing is marginal when an option on the market already exists. (p. 798)

I provide empirical evidence in Chapter 5 which is inconsistent with this hypothesis.

More recently, Allen and Gale (1994) interpret the findings of Detemple and Jorion as follows:

> On each [one of the 53 listing days], their results indicate that the market rises by approximately 1%. Based on this finding, one could argue that the total increase in the value of the market due to innovations in the option market may be as high as $(1.01)^{53} - 1 = 69\%$ or roughly two thirds. (p. 34)

Theoretical Papers Based on Market Completion

Ross (1976) shows that the introduction of options in an incomplete market increases the span of the investor's consumption space: "in an uncertain world, options written on existing assets can improve efficiency by permitting an expansion of contingencies that are covered by the market." (p.75). Thus, to the extent that options do complete the markets, they must have a real allocation impact contrary to the redundancy assumption embedded in the Black and Scholes (1973) model.

Detemple (1990) demonstrates that in an economy with incomplete markets, the introduction of a stock option generally changes asset prices and consumption bundles. He presents one example in which options decrease stock prices, as a result of a general portfolio re-balancing. Other examples show that stock prices may also rise, depending on initial endowment bundles or state probabilities. Like Ross (1976), this model can only predict that if options complete the markets, individual stock prices will be affected either upwards or downwards. The model does not predict the general direction of such price changes, or whether the aggregate effect is different from zero.

Detemple and Selden (1991) use a mean-variance economy to examine the impact of options on underlying stock prices. Assuming agents have different beliefs about the stock variance, but similar beliefs about its mean returns, they show that options increase stock prices.

The only empirical implication of theoretical models based on market completion is that options change stock prices if they complete the markets. The theory does not, however, provide inferences about the direction or magnitude of these price changes. While empirical studies confirm that stock prices generally react in response to option introductions, they cannot be directly tied to the predictions of any given model.

Other Theoretical Papers

Stein (1987) is the first theoretical paper to recognize that options need not necessarily complete the market in order to affect stock prices.[4] That is, even if options were totally redundant, their introduction may still affect the price of their underlying stocks. The core logic of Stein's model is as follows: (1) options are only redundant to

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[4] Stein's main analysis centers around the opening of a futures market, but his model can be easily extended to the opening of an options market, as indicated by the author himself: "A similar logic would apply to the opening of an options market (p. 131)."

option market makers, who are "endowed" with the Black and Scholes technology,[5] (2) the introduction of options attracts a new class of investors in the market: those who would have wanted to use options before, but were not endowed with the Black and Scholes technology,[6] (3) in some cases, the arrival of these new investors modifies the market information structure, leading to appropriate changes in underlying stock prices. The author summarizes his view on this point as follows:

> It is often claimed that "since options are redundant, they do not change the equilibrium asset prices." This would hold true only if everybody in the economy could borrow and lend costlessly so that introducing options changes nobody's opportunity set. But if this were the case, why would anybody trade in options at all? The Black-Scholes formula still holds when only some agents can borrow and lend costlessly, although asset prices cannot strictly be taken as exogenous: opening an option market indirectly changes asset demand, hence their price process. (p. 1130, emphasis added)

A second implication of Stein's model is that if the new class of investors consists mainly of speculators, the introduction of options may be welfare-reducing, leading to a drop in underlying stock prices.[7]

Back (1993) also demonstrates that the introduction of redundant options may affect stock prices, by modifying the market information structure. In his model options are ex-ante redundant, in the sense that the stock follows exactly the stochastic process postulated in the Black and Scholes paper, and the option market makers may freely and

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[5] That is, only option market makers can execute costless hedges. The other traders cannot.

[6] This class includes, among others, information traders and speculators, with no access to riskless hedges.

[7] A speculator in Stein's model is a trader who has a noisy observation of future stock values.

costlessly trade any quantities of stocks and/or bonds required to form a riskless hedge. That is, in Back's model options are totally redundant before they start trading.

However, in a market composed of both informed and uniformed traders, the author shows that the introduction of any new asset with nonlinear payoffs (such as an option) will change the portfolio allocation of the informed traders. Whereas in the stock-only economy all trades are restricted to one asset, in a stock-option economy the informed chooses an optimal trading strategy between stocks and options, to maximize his total returns on private information. By observing the trades occurring in the options market, the uninformed simply adjusts, in a Baysian fashion, his prior beliefs about the future states of nature. Thus, in this economy, every option trade reveals a new (and different) information structure. In a rational expectation framework, every option trade should therefore change underlying stock prices, depending upon the type of information being revealed. If there is sufficient information asymmetry in a given market, options which are ex-ante redundant become ex-post non-redundant, and no perfect hedge is available, even to option market makers with zero transaction costs.

Like models based on market completion, this model cannot predict the direction or magnitude of price changes following an option introduction. The model nevertheless has a very interesting, indirect empirical implication: if stock price changes around option listings are caused by a the revelation of new information, they should be correlated with unexpected earnings occurring immediately after listing.[8] Moreover, this effect should be stronger to the extent that informed traders switch their trades to the options market.

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[8] Unexpected earnings (or dividends) are defined as the actual earnings announced immediately after listing, minus the latest market expectation which precedes the listing

Koticha (1993) uses a similar framework to focus on the effect of options on the bid/ask spread of underlying stocks. In his model the informed makes a tradeoff between the higher leverage and the lower depth of the option markets when selecting a trading strategy. His main conclusion is that if option markets are sufficiently deep (i.e., the number of option noise traders is sufficiently high), the informed traders will move out of the stock market. This then reduces bid-ask spreads in the stock market. In reviewing his conclusion it is important to emphasize that the drop in the stock bid/ask spread occurs only if the options market is sufficiently noisy. The model does not permit to determine when this happens, since the relative number of noise traders in each market--a critical model variable--is exogenous (in this model) and cannot be measured empirically.

Conclusions of the Literature Review

Theoretical papers dealing with the effect of option introductions are generally based on two distinct premises: (1) options affect stock prices by completing the markets, and (2) options affect stock prices by unveiling a new informational structure. Though based on different economic foundations, both theories share essentially the same broad empirical implication: stock prices react when new options are introduced.

While empirical studies confirm that stock prices generally react in response to option introductions, the documented price effects are consistent with both market completion and information-based models.

This dissertation improves upon the previous literature in three respects. First, it analyses data from a longer time period, and shows that the price effect of option introductions becomes negative starting in 1981. Second, it shows that the positive price effect observed prior to 1980 is likely to be caused by stock price manipulation, not by general price changes resulting from market completion. Third, it shows that the negative price effect observed after 1980 may not be attributed to either a bias in the exchange selection process, or to the information hypothesis postulated in Back (1993).

CHAPTER 3
THE PRICE EFFECT OF OPTIONS INTRODUCTIONS REVISITED: 1973-1992

Introduction

This chapter investigates the price effect of options listed during 1973-1992, using the same methodology as Conrad (1989). The analysis repeats Conrad's study for a longer time period, and using a larger number of listing events.[1] Like Conrad, I find significantly positive price effects for options listed between 1973 and 1980. By contrast, I find significantly negative price effects for options listed between 1980 and 1992.

Data Sources and Methodology

The Chicago Board of Options Exchange provided listing dates for 1455 options listed on all organized options exchanges in the United States, since 1973. Since the list was accompanied by a disclaimer about possible errors in the data, each listing has been checked in the Wall Street Journal. Expiration dates for the first option contracts were also obtained from the Journal at the same time. When the CBOE information was not corroborated by the Journal, the observation was dropped from the dataset. More observations were dropped when the CRSP tapes did not contain sufficient data for underlying stock returns, either in the pre-listing or post-listing window.[2] This resulted in a

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[1] Conrad's study period ended at the end of 1980.

[2] At least 40 trading days were required in each period to calculate abnormal returns.

1237 "clean" listing events, which have been categorized as either (1) call-only, (2) joint put/calls, and (3) put-only. Of these, only 179 were call-only events, with options listed on the CBOE.

I investigate the price effect of option listings for 1973-1992, using the same methodology as Conrad (1989). Like previous authors I form equally weighted portfolios of stocks with identical option introduction dates, and treat them as single securities.[3] This eliminates possible biases coming from cross-sectional correlation in excess returns. I then estimate the market model over the 100 trading days preceding the listing, and use it to calculate abnormal returns for the 10-day window surrounding the listing date.

Empirical Results

When Conrad's analysis is repeated for all options listed on all major exchanges between 1973 and 1992, the positive price effect documented prior to 1980 becomes generally negative after 1980, as illustrated in Figure 1. To understand the reasons for this shift, I first try to establish whether 1980 marks a significant change in the nature (or characteristics) of the various option markets in the United States. Table 1 shows several descriptive statistics for new option contracts listed on U.S. exchanges between 1973 to 1992.[4] While the majority of option contracts listed prior to 1980 were calls only, there were four instances where calls and puts were listed at the same time. Panel A indicates that call-only listings continued to be most prevalent from 1981 to 1987, with only 5 out

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[3] See Conrad (1989) and Detemple and Jorion (1990).

[4] To preserve comparison with the rest of the dissertation, this table includes only options which meet the following two criteria: (a) the listing date has been verified in the Wall Street Journal, and (b) data for the underlying stock is available on the CRSP tapes for at least 40 trading days on either side of the listing event.

of 325 first-time listings being joint put/calls. After 1987, put/calls became the norm. Because the change from a call- to a put/call-dominated market occurred in 1987, it does not appear to be related to the 1980 price-effect shift illustrated in Figure 1.

The middle section of Panel A shows a breakdown of all first option contracts according to the exchange where they were listed. While the number of option exchanges increased through time, no significant change in the listing pattern is observed in 1980.

The last two columns of Panel A show that prior to 1985 all optioned underlying stocks were traded on either NYSE or AMEX. Starting in 1985, NASDAQ-traded stocks also became optioned, in roughly equal proportions to NYSE/AMEX stocks. This change, however, occurred five years after 1980, and does not appear to be related to the pattern observed in Figure 1.

Panel B illustrates the change in the size of the "typical" optioned firm, by comparing mean and median market capitalizations across time. Two measures of market capitalization are used: the current-dollars measure, and an inflation-adjusted, constant-dollars measure, using the 1983 CPI as a deflator. It becomes readily apparent that firms which became optioned during 1973 or 1974 were substantially larger than firms optioned in subsequent years, with median market capitalization in excess of $7 Billion (constant, 1983 dollars). Starting in 1975, and especially after 1976, the average size of the optioned firm became much smaller, and remained relatively constant throughout the rest of the sample period. Since the most significant change occurred in 1976, firm size does not appear to be related to the Figure 1 pattern.

Table 2 presents a more formal analysis of the results illustrated in Figure 1. This table shows--for various sub-samples--the mean cumulative abnormal returns (CARs) experienced by underlying stocks during the ten-day window surrounding the listing date. Panel A of Table 2 shows results for all stocks which became optioned for the first time, either with call-only contracts or joint put/call contracts. In agreement with previous studies, I find that for the first sub-period (1973-1980) CARs were strongly positive (2.47%) and significantly different from zero at better than the 1% level (t=4.66). When the same analysis is repeated to the second sub-period (1981-1992), the opposite obtains: CARs become negative (-1.03%), and significantly different from zero at better than the 2% level (t=-2.49). In an attempt to explain the switch in the sign of the CARs, I repeat the analysis from Panel A for different sub-samples of my original data.

Panel B shows the results for call-only events, whereas Panel C shows the results for put/call events. By comparing the two panels, it appears that the post-1980 negative CARs are especially driven by joint put/call listings, with abnormal returns of -1.34% (t=-2.55), compared to -0.55% (t=-0.84) for call-only listings. However, this does not seem to account for the reversal in the sign of the CARs shown in Panel A, which still persists--in a milder form--in the call-only sub-sample: the mean price effect in the post-1980 period is significantly lower than in the pre-1980 period (-2.94%, t=-3.46).

Panel D repeats the analysis for put-only listings, but finds no significant results in either period. It should be noted that put-only listings <u>always</u> followed call-only listings for the same stock. In other words, each time a put option was listed on a given stock, a call option for the same stock was already trading.

Panels E and F show that the exchange on which the underlying trades does not affect the way in which it reacts to its option introduction: while NASDAQ stocks were not optioned in the first sub-period, when they do become optioned (in the second sub-period) they react similarly to contemporaneous NYSE/AMEX stocks. Moreover, the CAR sign reversal continues to persist for NYSE stocks in Panel E.

Panel G uses a sub-sample of all stocks, for which bid/ask quotes are available on the NASDAQ-NMS tape, to determine whether the negative CARs computed from transaction data are merely resulting from more trades occurring at the bid quote during the event window. Even when bid/ask averages are used instead of transaction prices, the negative CARs persist.

Panels H through L show that the CAR sign reversal documented in panel A is driven mostly by options listed on CBOE, AMEX and PSE. PHLX option listings cause a similar, but smaller (and insignificant) effect, whereas options listed on NYSE seem to have no impact on the price of their underlying stocks.

It therefore appears that the shift from a positive to a negative price effect occurring at the end of 1980 is unrelated to either the type of option contracts being listed, the relative size of the optioned firm, the exchange on which the stock trades, or the method used to estimate abnormal returns. The rest of the dissertation argues the following:

1. The pre-1980 positive price effect <u>is not</u> a permanent price change, but rather a temporary price run-up, induced by option dealers manipulating stock prices around the date of option introduction.

2. Regulatory changes introduced at the end of 1980 successfully prevented stock price manipulation from re-occurring. However, instead of merely vanishing after 1980, the price effect of option introductions becomes negative starting with 1981.

3. This negative, post-1980 price effect is not consistent with the selection bias hypothesis, according to which exchanges only list options on stocks that have over-performed the market in the past. Nor is it consistent with the information hypothesis, which states that options reveal the content of privately held information at the time of listing.

4. The post-1980 negative price effect is however permanent, and persistent. This suggest that option listings are causing a drop in the equilibrium price of underlying stocks.

5. A longer term negative price effect is discernible even prior to 1980, after the initial (manipulation-driven) price run-up disappears. As in the post-1980 period, this longer term price effect also appears to be permanent.

6. Overall, the dissertation asserts that the true price effect of option introductions is negative. This price effect is readily observed around listing date in the post-1980 period, when the data are not affected by manipulation activities. Moreover, this price effect is also discernible in the pre-1980 period, after the manipulation-driven price run-up disappears at the end of the first contract expiration period.

7. Understanding the cause of the true price effect of option introductions remains an important issue for further research.

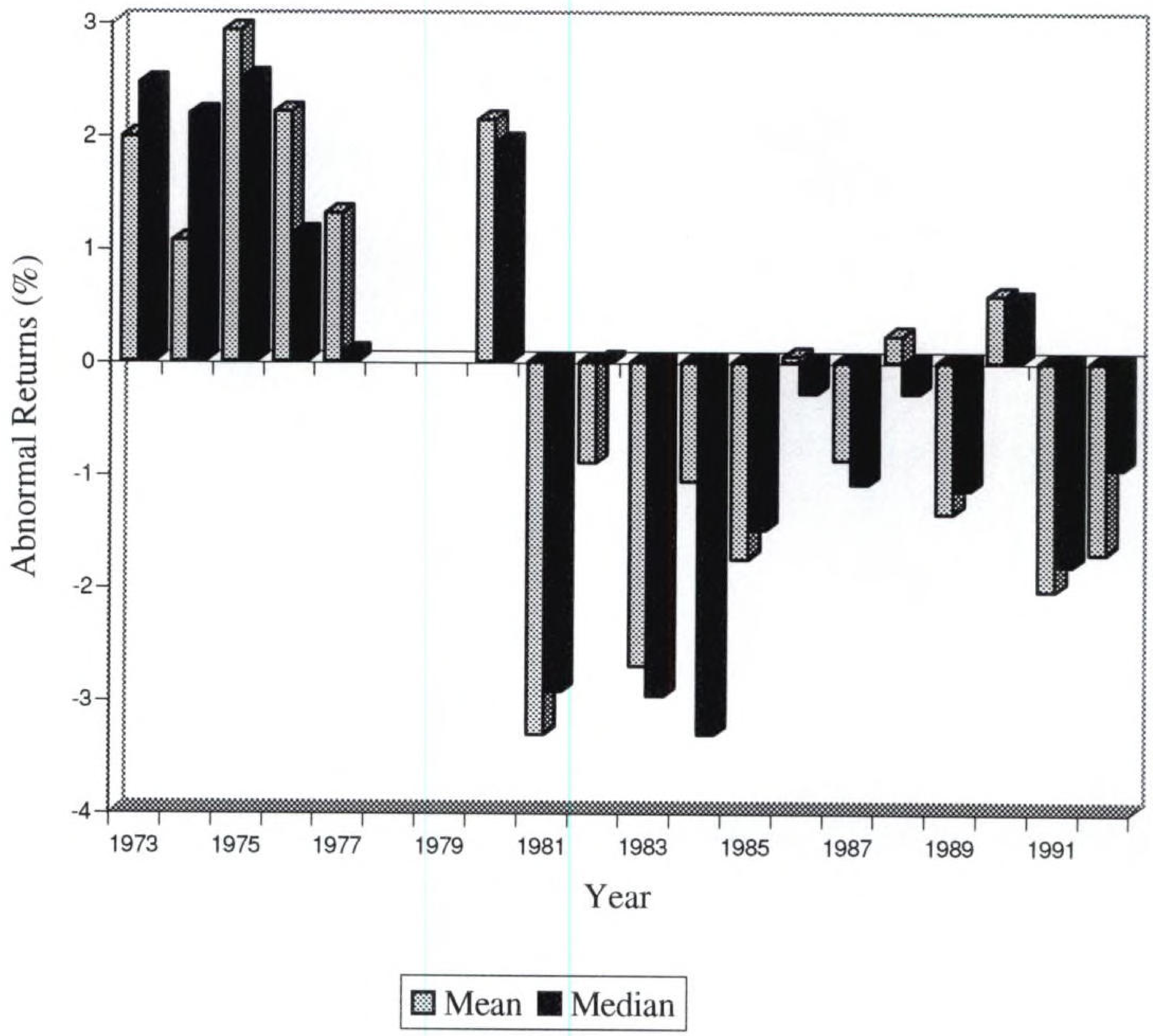

Figure 1:
Stock mean abnormal returns
around the first option listing date:
1973-1992

Table 1: Descriptive statistics

Panel A: Summary of new stock option contracts: 1973-1992

Year	Number of Options Listed (by Type)				Number of Options Listed (by Exchange) - - Calls and Put/Calls Only						Underlying Stock Exchange	
	C	P/C	P	ALL	CB	AM	NY	PS	PH	MS	NY	NSD
1973	26	- -	- -	26	26	- -	- -	- -	- -	- -	26	- -
1974	6	- -	- -	6	6	- -	- -	- -	- -	- -	6	- -
1975	84	- -	- -	84	34	41	- -	- -	9	- -	84	- -
1976	59	- -	- -	59	7	15	- -	15	16	8	59	- -
1977	19	- -	22	41	1	3	- -	8	6	4	19	- -
1978	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1979	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1980	40	4	29	73	5	18	- -	12	9	- -	44	- -
1981	8	3	49	61	3	2	- -	3	3	- -	11	- -
1982	79	- -	1	80	23	18	- -	19	19	- -	79	- -
1983	28	- -	- -	28	6	10	- -	5	7	- -	28	- -
1984	12	- -	- -	12	5	5	- -	- -	2	- -	12	- -
1985	49	1	- -	50	18	21	8	11	5	- -	29	21
1986	39	- -	1	40	10	12	4	7	7	- -	23	16
1987	105	1	- -	106	19	24	16	26	23	- -	85	21
1988	11	77	4	92	25	23	13	16	15	- -	51	37
1989	4	84	- -	88	21	27	9	17	17	- -	56	32
1990	- -	124	- -	124	39	29	18	25	32	- -	81	43
1991	20	131	- -	151	46	48	31	49	49	- -	68	83
1992	13	102	1	116	64	36	8	20	17	- -	44	71

Table 1. Continued

Note:

This table only includes options which meet the following two conditions:

- The listing date has been verified in the Wall Street Journal, and
- The CRSP tapes contain data for at least 40 trading days on either side of the listing event.

Abbreviations:

- C: Call contracts only.
- P/C: Joint put/call listings.
- P: Put listings only.
- ALL: The total of calls, put/calls, and put listings.
- CB: Chicago Board of Options Exchange.
- AM: American Stock Exchange
- NY: New York Stock Exchange
- PS: Philadelphia Stock Exchange
- MS: Midwest Stock Exchange
- NSD: National Association of Security Dealers Automated Quote (NASDAQ)

Table 1. Continued

Panel B: Market capitalization of newly-optioned stocks: 1973-1992 (Calls and Put/Calls only)

Year	Market Capitalization in Current Dollars				Market Capitalization in Constant (1983) Dollars			
	Mean	Std. Dev.	Median	I.Q. Range	Mean	Std. Dev.	Median	I.Q. Range
1973	6,549	9,672	3,422	5,439	14,701	21,441	7,715	12,347
1974	4,361	3,871	3,633	6,725	8,403	7,458	7,001	12,957
1975	1,587	1,526	1,031	1,702	2,989	2,895	1,927	3,234
1976	877	868	537	754	1,542	1,532	956	1,283
1977	677	695	469	316	1,135	1,161	793	532
1978	- -	- -	- -	- -	- -	- -	- -	- -
1979	- -	- -	- -	- -	- -	- -	- -	- -
1980	1,063	1,349	535	647	1,286	1,634	656	780
1981	796	459	649	724	867	497	704	791
1982	2,633	15,403	588	687	2,763	16,214	616	722
1983	653	556	477	572	653	554	479	564
1984	2,493	2,462	1,428	3,392	2,387	2,365	1,384	3,211
1985	1,959	2,345	965	1,744	1,811	2,163	891	1,645
1986	1,298	801	1,198	1,000	1,183	731	1,095	903
1987	2,116	2,893	1,437	1,747	1,864	2,518	1,274	1,533
1988	988	776	819	888	827	648	684	730
1989	1,224	3,165	528	751	978	2,517	427	591
1990	2,200	6,990	767	1,126	1,678	5,362	585	824
1991	670	1,226	405	435	490	895	295	319
1992	422	448	289	285	300	318	204	205

Abbreviation:

- I.Q.: Inter-quartile range

Table 1. Continued

Note:

In order to be included in these calculations, a firm must meet the following criteria:

- The firm's stock became optioned for the first time during the year shown, with either call-only contracts, or joint put/call contracts. Put-only contracts are always listed after calls, and are therefore excluded;

- The listing date of the call contract has been verified in the Wall Street Journal; and

- The CRSP tapes contain data for at least 40 trading days on either side of the listing event.

Table 2: Cumulative Abnormal Returns (CARs) of optioned stocks during the ten-day window around listing date.

When more than one stock became optioned on a given day, a portfolio of all such stocks is formed, and subsequently considered a single security. Abnormal returns are calculated using the Brown and Warner (1985) methodology. The benchmark period extends from day L-100 to L-6, where L represents the listing date. The event window extends from L-5 to L+5. This 10-day window was selected to preserve comparison with previous studies.

Panel A: All stocks, all call and put/call listings.

Period	Number of Events	CAR(s) -- Market Model	T-statistic -- Market Model	CAR(s) -- Constant Ret. Model	T-statistic -- Constant Ret. Model
1973-1980	83	2.47%	*4.66****	2.54%	*3.72****
1981-1992	427	-1.03%	*-2.49***	-1.05%	*-2.38***

Panel B: All stocks, call options only

Period	Number of Events	CAR(s) -- Market Model	T-statistic -- Market Model	CAR(s) -- Constant Ret. Model	T-statistic -- Constant Ret. Model
1973-1980	82	2.39%	*4.41****	2.45%	*3.58****
1981-1992	170	-0.55%	*-0.84*	-0.51	*-0.72*

Panel C: All stocks, put/calls only

Period	Number of Events	CAR(s) -- Market Model	T-statistic -- Market Model	CAR(s) -- Constant Ret. Model	T-statistic -- Constant Ret. Model
1973-1980	--	--	--	--	--
1981-1992	261	-1.34%	*-2.55***	-1.39%	*-2.56***

Table 2. Continued

Panel D: All stocks, put options only

Period	Number of Events	CAR(s) -- Market Model	T-statistic -- Market Model	CAR(s) -- Constant Ret. Model	T-statistic -- Constant Ret. Model
1973-1980	9	-1.06%	*-0.66*	2.84%	*1.25*
1981-1992	10	-0.03%	*-0.01*	0.08%	*0.03*

Panel E: NYSE/AMEX stocks only, calls and put/calls

Period	Number of Events	CAR(s) -- Market Model	T-statistic -- Market Model	CAR(s) -- Constant Ret. Model	T-statistic -- Constant Ret. Model
1973-1980	83	2.52%	*4.73****	2.63%	*3.82****
1981-1992	275	-0.80%	*-2.16***	-0.71%	*-1.64**

Panel F: NASDAQ stocks only, calls and put/calls

Period	Number of Events	CAR(s) -- Market Model	T-statistic -- Market Model	CAR(s) -- Constant Ret. Model	T-statistic -- Constant Ret. Model
1973-1980	--	--	--	--	--
1981-1992	208	-1.61%	*-2.16***	-1.59%	*-1.99***

Panel G: NASDAQ-NMS stocks only, calls and put/calls, returns calculated using bid/ask averages

Period	Number of Events	CAR(s) -- Market Model	T-statistic -- Market Model	CAR(s) -- Constant Ret. Model	T-statistic -- Constant Ret. Model
1973-1980	--	--	--	--	--
1981-1992	203	-1.62%	*-2.26***	-1.62%	*-2.06***

Table 2. Continued

Panel H: CBOE options only, calls and put/calls

Period	Number of Events	CAR(s) -- Market Model	T-statistic -- Market Model	CAR(s) -- Constant Ret. Model	T-statistic -- Constant Ret. Model
1973-1980	23	3.85%	*4.17****	3.51%	*2.98****
1981-1992	151	-1.38%	*-2.12***	-1.36%	*-2.01***

Panel I: AMEX options only, calls and put/calls

Period	Number of Events	CAR(s) -- Market Model	T-statistic -- Market Model	CAR(s) -- Constant Ret. Model	T-statistic -- Constant Ret. Model
1973-1980	23	3.04%	*2.61***	4.46%	*3.06****
1981-1992	159	-1.79%	*-2.33***	-1.79%	*-2.13***

Panel J: PSE options only, calls and put/calls

Period	Number of Events	CAR(s) -- Market Model	T-statistic -- Market Model	CAR(s) -- Constant Ret. Model	T-statistic -- Constant Ret. Model
1973-1980	19	1.95%	*1.49*	2.89%	*1.74**
1981-1992	112	-1.92%	*-2.05***	-1.97%	*-1.97**

Panel K: PLHX options only, calls and put/calls

Period	Number of Events	CAR(s) -- Market Model	T-statistic -- Market Model	CAR(s) -- Constant Ret. Model	T-statistic -- Constant Ret. Model
1973-1980	25	1.05%	*0.98*	-0.54%	*-0.42*
1981-1992	104	-0.31%	*-0.47*	-0.71%	*-0.99*

Table 2. Continued

Panel L: NYSE options only, calls and put/calls

Period	Number of Events	CAR(s) -- Market Model	T-statistic -- Market Model	CAR(s) -- Constant Ret. Model	T-statistic -- Constant Ret. Model
1973-1980	--	--	--	--	--
1985-1992	44	0.85%	*0.75*	0.99%	*0.79*

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level
-- Insufficient data

Variable Definition:

- Number of Events: Number of days during which one or more option contracts get listed.

- CARs (Market Model): Cumulative abnormal returns, from day L-5 to L+5, calculated using the market model estimated from L-100 to L-6.

- CARs (Constant Ret. Model): Cumulative abnormal returns, from day L-5 to L+5, based on the mean portfolio returns estimated from L-100 to L-6.

CHAPTER 4
THE REGULATORY ENVIRONMENT OF STANDARDIZED OPTION TRADING: 1973-1992

Introduction

Stock options have been traded over the counter in the United States since the early Twentieth Century. Rule 9b-1 of the Security and Exchange Act of 1934 prohibited any transaction in puts, calls, straddles or other options, except in accordance with a plan established by the exchange, that the SEC had determined to be "in the public interest and for the protection of investors." In the early part of 1973 the Chicago Board Options Exchange (CBOE) submitted under rule 9b-1, a plan for the initiation of standardized options trading. The SEC was particularly concerned that standardized option trading "may involve complex problems and special risks to investors and to the integrity of the market place" (SEC Release No. 34-10552). Accordingly, it decided to approve the CBOE plan, on an experimental basis, and only on condition that "the economic benefits of options ownership outweigh the dangers of options trading." [1] That is, the SEC reserved the right to terminate the plan, if subsequent evidence indicated that options were harmful. Throughout the mid 1970s, the SEC also authorized the American, Philadelphia, Pacific and Midwest Stock Exchanges to implement similar plans, on similar experimental conditions.

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[1] Securities Exchange Act Release No. 34-10552

The Options Study

The early years of standardized option trading were marked, on the one hand, by a sharp rise in trading volume, and on the other, by numerous instances of unethical sales practices, fraud, and stock price manipulation.[2]

In addition, as option volume grew by a factor of 30 in less than three years, the SEC became particularly worried that option trading might draw investor capital away from equity securities: "[The Chairman of the SEC] is concerned that options trading is drawing off investors' funds that otherwise might be going to smaller companies in need of speculative capital." (WSJ, 8/3/76.) In July of 1977, as the overall effect of option trading became questionable, the SEC felt it appropriate to review the experimental standardized option trading programs. Accordingly, it ordered a comprehensive study on this subject (the Options Study), and imposed a moratorium on any new option listings. (That is, the SEC asked all option exchanges to refrain from initiating trading in new options until further notice.)

At its inception, the Options Study had two main objectives. First, it was to investigate alleged instances of fraud, price manipulation, unethical sale practices and inadequate surveillance systems in all options exchanges. If sufficient evidence were found in support of these allegations, the Study was to recommend specific regulatory changes and disciplinary sanctions, in order to prevent re-occurrences.

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[2] See, among others, "J. Newmann cited for Manipulation of Stock Prices," in The Wall Street Journal, Jan 26, 1978.

Second, the Study was to assess the impact of options upon the integrity of the stock market and its capital raising function, in order to determine whether options are "consistent with fair and orderly markets, the public interest [and] the protection of investors" or whether they "represent a threat to the integrity of the capital raising function of the securities markets." (Securities Exchange Act Release No. 34-14056. Emphasis added.) It quickly became clear that this second objective could not be accomplished with only four years of trading data.

In 1978, the SEC directed the Study exclusively towards its first objective, leaving the broader question of economic impact to others. Upon its completion in 1979, the Study made a number of recommendations, which--for the most part--fell under two broad categories: increase in the quality of information available to investors and prevention of stock price manipulation.

Regulatory Changes Related to the Quality of Information Available to Investors

In order to protect inexperienced investors from the dangers of options trading: (i) option brokers had to disclose complete information to all prospective traders, including the average performance of all accounts, the realized rate of return net of transaction costs and a disclaimer that past performance is not an indication of future performance; (ii) during option seminars conducted by brokerage firms the financial interest of these firms had to be clearly disclosed; (iii) option brokers had to complete an SEC-approved training course; and (iv) option brokers had to ensure that potential customers have a thorough understanding of options, before they could recommend options as an investment instrument. The majority of these recommendations were successfully implemented between February 1979 and March 1980. Later that month, the SEC lifted its three-year long moratorium and allowed exchanges to once again initiate trading in new option contracts.

Regulatory Changes Related to the Prevention of Stock Price Manipulation

The Options Study observed that between 1973 and 1980, the Federal Reserve Board in essence permitted option dealers to purchase unlimited quantities of underlying stock without providing any margin deposit. This practice was made possible by inadequate regulations, and encouraged option dealers to manipulate underlying stock prices in order to increase their gains from call writing. At the end of 1980 the Federal Reserve severely restricted the availability of zero-margin credit to option dealers, discouraging stock price manipulation from re-occurring. In the following paragraphs I briefly describe the regulatory environment of option dealer margins between 1973 and 1980, and show that the two regulatory regimes prior to 1980 permitted stock price manipulation. I then examine the regulatory changes implemented at the end of 1980, and explain how the post-1980 regime substantially eliminated opportunities for manipulating underlying stock prices.

The "Good Faith Credit" Regime: 1973-1977. When standardized option trading begun, option dealers did not have to provide any margin deposits for the purchase of underlying stocks, so long as the acquired stocks were used for hedging their option positions.[3] However, the Federal Reserve did not specify the precise amount of stock that qualified for credit under this rule, leaving it to individual market makers to determine "in

[3] Other option dealer transactions were subject to the usual 50% margin requirements.

good faith" the appropriate quantity required for hedging. By 1977 the Federal Reserve observed that this leniency gave way to regular abuses as many market makers acquired substantially larger quantities of stock than those economically required for hedging, and misrepresented these transactions as being hedge-related. In April of 1977 the Federal Reserve issued a proposed rule change, according to which stock credit for option dealers would be made available only under the following terms:

> (i) For options in- or at-the-money, one share of stock per option outstanding may be purchased with a reduced, 25% margin requirement instead of the usual 50%. Zero-margin credit was no longer available.
>
> (ii) In all other cases, underlying stock transactions were subject to the regular 50% margin requirements.

Although the Federal Reserve never adopted this proposed rule, on June 20, 1977 the Securities and Exchange Commission asked the Option Clearing Corporation to finance option dealer accounts in accordance with the April 1977 rule proposal as if it were in effect. (Options Study, p. 679.) That is, starting in June of 1977, the "good faith," zero-margin requirement has been replaced with a 25% margin requirement for stocks used to offset in- or at-the-money calls, and a 50% margin for all other stocks.

The "Free Riding" Regime: 1977-1980. The Options Study, however, observed that the regulatory change implemented in June of 1977 was inadequate, and did not prevent option dealers from trading excessive stock quantities without margin. This is because after the end of the "good faith credit" regime, option dealers quickly devised a scheme (later called "free riding") which in essence allowed them to circumvent the newly imposed margin requirements, and continue to control large quantities of stocks with no margin deposits. Taking advantage of a regulatory inefficiency not corrected by the June

1977 rule change, the scheme consisted of acquiring the underlying stock position, selling it back at the end of the five-day grace period, and buying it back immediately thereafter. When this procedure was repeated every five days for an extended period, the option dealer was in effect "acquiring" the underlying stock without having to maintain a margin deposit. The Federal Reserve Board did not prohibit "free-riding" at the time, but stock exchanges had adopted rules which prohibited free riding, <u>except for</u> option dealers' stock transactions which were executed as a "good faith" hedge for an options position:[4]

> The practice of acquiring a stock position and liquidating it within five business days without making a required margin deposit is called "free-riding." The Federal Reserve Board does not prohibit free-riding but all self-regulatory organizations have adopted rules which prohibit their broker-dealer member firms from permitting a public customer to engage in free riding. The self regulatory organization regulations, however, have not been applied to market maker stock transactions, For that reason, an options market maker has five business days within which to liquidate a stock position <u>without making a margin deposit</u> when the stock was originally acquired as a bona fide hedge of an options position.
>
> Some option market makers have made a practice of selling their stock within this five day period and then immediately repurchasing the stock to avoid the necessity of putting up a margin deposit. This practice permits the options market maker to speculate in the stock underlying an option without being required to maintain a margin deposit. (...) The Options Study does not believe that this type of activity contributes to an orderly market or to the financial integrity of the options market. (Options Study, p. 681, emphasis added)

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[4] Thus, option dealers were given preferential treatment over all other stock investors. To better appreciate this difference, consider the following example: If on day 0 an option dealer purchases 100 shares of stock at $1 per share, he owes his creditor the amount of $100 on day 5. If on day 4 he sells his position, he no longer has to pay the $100 on day 5. At the end of day 4 the option dealer can repeat the procedure for another five days, and can continue to do so every five days for an unlimited period. This in essence allows him to control the stock with zero margin. The difference between an option dealer and an "ordinary" investor is that the ordinary investor who sells the stock on day 4 must still provide the margin deposit on day 5, and collect the proceeds on day 9.

The "Permitted Credit" Regime: Post-1980. Whether de jure (1973-1977) or de facto (1977-1980), the availability of unlimited, zero-margin credit made it possible for option dealers to control large quantities of underlying stocks with no up front investment. Both the SEC and the Federal Reserve believed that a change in margin regulations was necessary to discourage manipulation in underlying stock prices. On August 11, 1980, the Federal Reserve officially prohibited "free riding," except for the quantities of stock legitimately required for hedging, which it referred to as "permitted offset positions." These quantities were defined as one share of stock for every call option which is in- or at-the money, and zero shares for options which are out-of-the-money. When a stock purchase did not qualify as a "permitted offset position," the option dealer was compelled to provide the margin deposit by the end of the fifth business day after the purchase, even if he had sold the stock in the mean time. Failure to do so will preclude him from obtaining any credit for stock purchases during the following 15 business days.[5] This new regime in essence created two separate classes of underlying stock transactions, subject to separate margin requirements and differential "free riding" treatments:

> (i) Permitted offset stock positions, consisting of one share of stock for each outstanding call option in- or at-the-money. This class was subject to a 25% margin requirement. However, "free riding" continued to be permissible, which resulted in an effective zero margin requirements for stocks belonging to this class.
>
> (ii) "Ordinary" stock positions, consisting of all other stock transactions which did not qualify as "permitted offset positions." This second class was subject to a 50% margin requirement, and "free riding" was no longer allowed. If convicted of "free riding," the option dealer

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[5] Federal Register, 6/17/1980, pp. 40967-8. The CBOE has characterized this 15-day penalty as "unduly harsh".

would no longer be able to obtain stock credit for a period of 15 days, for both "ordinary" and "permitted offset" stock purchases.

Individual exchanges were allowed to make minor modifications to the new policy, so long as they did not contradict the essence of the Fed's ruling. The Philadelphia Stock Exchange decided to follow the ruling without further revisions. The other three exchanges proposed minor modifications, which were subsequently accepted by both the SEC and the Federal Reserve. The effective enforcement date of the new policy therefore varied according to the following schedule:

Philadelphia Exchange:	August 11, 1980
Chicago Board Options Exchange:	September 4, 1980
Pacific Stock Exchange:	December 26, 1980
American Stock Exchange:	March 16, 1981.

The Options Study thus observed that between 1973 and 1980 the availability of "good faith credit," followed by the practice of "free riding" permitted option dealers to control large quantities of stock without providing any margin deposit. This made it possible for them to manipulate underlying stock prices in order to increase profits from call writing. I test this assertion in Chapter 5, and show that the positive price effect observed prior to 1980 is consistent with stock price manipulation: option dealers acquiring excessive stock quantities around option introductions, in order to sell "overpriced" call options to the inexperienced investor. When excessive "free riding" was no longer permissible at the end of 1980, the abilities of option dealers to purchase underlying stocks with zero margin deposit were limited to at most one share of stock per outstanding call option. Since substantially larger stock quantities are required to influence prices in the desired direction, the profitability of stock price manipulation considerably diminished after the end of 1980.

Multiple Listings of Options

In a world with perfect competition among option dealers, manipulation of underlying stock prices requires a collusion which may not always be sustainable in equilibrium, since at any time an individual dealer may have the incentive to deviate from the collusion, for example by short-selling the stock which is being manipulated. Thus, if multiple listings of options were allowed prior to 1980, the market manipulation argument would be substantially weakened.

A brief examination of the regulatory environment reveals that between 1973 and 1980 only 22 call contracts were traded on more than one exchange. None of these contracts, however, has been listed simultaneously on more than one exchange: the listing on the second (and third) exchanges always lagged by at least three months the listing on the first exchange (usually the CBOE). Rule changes implemented in 1980 completely prohibited multiple listings until 1989, when the SEC decided to allow unrestricted multiple listings. The regulatory regime pertaining to multiple listings may therefore be summarized as follows:

1973-1980: Sequential multiple listing only occurred for 22 stocks. First time option contracts were always listed on only one exchange

1980-1989: No multiple listings allowed. Exchanges had to select optionable stocks according to an agreed-upon rotation system.

1989-1992: Simultaneous and sequential multiple listing allowed without restrictions.

Since no simultaneous multiple listings occurred between 1973 and 1980, market manipulation could have persisted as a sustainable equilibrium during that period.

CHAPTER 5
EVIDENCE OF STOCK PRICE MANIPULATION AROUND OPTION INTRODUCTIONS: 1973-1980

Introduction

In this chapter I investigate whether the pre-1980 positive price effect is consistent with option dealers manipulating stock prices. As a first step, I show that under the pre-1980 margin regulations, option dealers had both the incentives and opportunities to manipulate underlying stock prices. Subsequently, I identify the empirical effects of market manipulation, and show that they are supported by the data.

How Does Market Manipulation Work?

Market manipulation is the process by which option dealers attempt to control stock prices, to benefit from their call option positions. In particular, option dealers would like to artificially inflate stock prices just before the first option contract begins trading, in order to sell over-priced calls. As this first contract approaches expiration, option dealers would like to depress stock prices, to reduce the call's terminal value (which corresponds to the option dealer's liability). The profit derived from market manipulation therefore corresponds to the difference between the "artificially inflated" call price, and its "true" price that would have obtained in a non-manipulated economy.

To the extent that stocks have a down-sloping demand (Shleifer, 1986), stock prices can be manipulated as follows: First, option dealers acquire a large inventory of underlying stocks before the option contract begins trading. (This pushes call prices above their "true" values.) Since option dealers must also purchase underlying stocks for legitimate hedging activities, this acquired inventory represents shares purchased in excess of those required for hedging. As the option contract approaches expiration, option dealers liquidate their excessive stock inventory, placing downward pressure on underlying prices. This lowers both stock and call prices towards their "true" levels.[1] Clearly, the availability of free credit for underlying stock purchases prior to 1980 provides an unique opportunity for option dealers to manipulate stock prices during that period.

When Will Market Manipulation Work Better?

Since market manipulation involves a round trip stock transaction, it will only be profitable when the gains realized from call writing exceed the losses incurred in stock trading. The option market maker's expected gains resulting from manipulation can be calculated as follows:

$$E_t\{Profit\} = C_t \cdot \left[P_c^* - P_c\right] - m \cdot N \cdot r \cdot Askprice_t + N \cdot [E_t\{Bidprice_{t+1}\} - Askprice_t] \qquad (1)$$

where:

- C is the initial number of call contracts written;
- P_c^* is the effective sale price of each call contract, based upon the artificially inflated stock price in effect at time t;
- P_c is the "true," arbitrage-based price of a call contract, which would have obtained in the absence of stock price manipulation;
- N is the number of underlying shares transacted, in excess of the number otherwise required for hedging[2];

[1] In some cases option market makers have allegedly caused options to expire worthless.

[2] As discussed in Chapter 4, up to one share of stock per outstanding call option can be purchased without margin deposit throughout the entire sample period, from 1973 to 1992. To the extent that manipulating stock prices requires the purchase of substantially

- m is the effective margin requirement applicable to the stock purchase at time t;
- r is the opportunity rate of return on an alternative investment;
- *Ask price* is the mean purchase price of the stock position at time t;
- *Bid price* is the mean sale price of the stock position at time $t+1$;
- t is the time of the stock purchase and initial call writing; and
- $t+1$ is the time when the stock is sold and the call contract expires.

The first term of equation (1) represents the profits realized from selling overpriced calls. It is equal to the difference between the net proceeds from call writing under stock price manipulation and the net proceeds from call writing when no attempts are made to influence stock prices.

The second term of equation (1) represents the opportunity cost of investing $\$(m \bullet N \bullet AskPrice_t)$ at time t into the manipulation "technology": when option dealers are required to maintain a positive margin deposit m, they are foregoing alternative investment opportunities for the time period ranging from t to $t+1$. The analysis presented in Chapter 4 shows that the value of m through time varies as follows:

- from 1973 to 1977, m=0, de jure;
- from 1977 to 1980, m=0, de facto;
- starting in 1981 (both de jure and de facto):
    - for options out-of-the money, $m=0.5$, for any quantity traded;
    - for options in- or at-the money, $m=0.5$, for all shares traded in excess of one per outstanding option contract.

The third term in equation (1) represents the actual loss resulting from the round-trip stock transaction. It is equal to the net loss incurred for each stock share transacted for manipulative purposes, times the total number of shares transacted.

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more shares, the margin ratio of interest in this chapter is the one that applies to trades in underlying stock in excess of those quantities which are exempt from margin deposits.

Equation (1) therefore predicts that market manipulation is likely to be more effective under the following circumstances:

First, manipulative costs are substantially reduced when m=0, as the second term in equation (1) becomes zero. Accordingly, market manipulation should be more apparent between 1973 and 1980, and less apparent starting in 1981, when the value of m jumps from 0% to 50%.

Second, the incentives to manipulate are substantially diminished in the post-1980 regime, where option dealers are subject to differential margin requirements, depending on whether the call option is in- or out-of-the-money. In the pre-1980 regime option dealers find it lucrative to write calls when stock prices are artificially inflated, because most calls would finish out-of-the-money once stock prices revert to their normal level. With the post-1980 differential margin requirements, forcing options out-of-the-money is no longer profitable, since the margin ratio increases from 0 to 0.5, making the hedging operations more costly. I therefore expect, once again, to find more evidence of market manipulation after 1980, when differential margin requirements are in effect.

Third, assuming that the net proceeds from the stock transactions are negative, the third term in equation (1) shows that manipulation is more profitable when N is small, i.e. when only small stock quantities are required to move stock prices in the desired direction. To the extent that market capitalization is inversely related to firm size (Shleifer, 1986), I expect market manipulation to be more apparent for firms with small market capitalization.

Fourth, if option dealers make money by forcing calls to expire worthless, they should be manipulating mostly stocks for which the term $[P^*_c - P_c]$ is larger. An examination of a simple two-state, two-period option pricing model reveals that the term $[P^*_c - P_c]$ is greater for stocks with large volatilities.[3] Accordingly, I expect market manipulation to be especially discernible for more volatile stocks.[4]

Lastly, market manipulation is not likely to be profitable when both calls and puts are introduced simultaneously, since by artificially inflating call prices, the market maker necessarily deflates put prices. Accordingly, this chapter considers call-only introductions throughout the entire sample period.

What Are the Empirical Effects of Market Manipulation?

The first empirical effect consistent with market manipulation is that if the "good faith credit" and "free riding" regimes encouraged manipulative activities, their replacement with the "permitted credit" regime at the end of 1980 should have prevented market manipulation from reoccurring. This suggests that option listings should cause a positive price effect before 1980, and no price effect afterwards.

In addition, if stock prices are manipulated, they should exhibit only temporary positive cumulative abnormal returns (CARs) around the date of their option listing. That is, if stock prices are artificially inflated during the listing window (in order to increase profits from option writing), they should subsequently drop to their normal "equilibrium"

[3] The proof is presented in the appendix.

[4] One can argue that the more volatile stocks also present the greatest risk for the manipulator. However, in a risk neutral environment, the only relevant losses resulting from the stock transaction are those shown in equation (1), and do not directly depend on stock volatilities.

levels. However, as discussed in sub-section B above, some stocks are more likely to be manipulated than others. Thus, a second empirical implication is that small stocks with large historical stock return standard deviations should exhibit a stronger price effect during listing, and a stronger price reversal after listing. By contrast, large stocks with low historical stock return standard deviations should exhibit little listing effect or post-listing reversal.

Lastly, when option dealers attempt to manipulate stock prices, they must acquire an abnormally large number of outstanding shares. The third empirical implication is therefore that higher share turnover should obtain when stock prices are manipulated.

Methodology.

To detect market manipulation I first form a sample composed of all 179 CBOE call options listed between 1973 and 1992. I then divide it into two sub-samples, according to the regulatory environment in effect at call listing date: (a) pre-moratorium listings (1973-1980), and (b) post-moratorium listings (1981-1992). For each sub-sample I use the listing price effect and abnormal share turnover as proxies for the occurrence of stock price manipulation.[5] Lastly, I perform the market manipulation tests, which generally fall into three broad categories:

[5] While high abnormal turnover is definitely consistent with the occurrence of stock price manipulation, it is also possible that high turnover may reflect the endogeneity of the listing decision (i.e. exchanges listing options when stock turnover is high). Abnormal turnover is therefore used only in conjunction with abnormal returns in all market manipulation tests presented in this chapter.

Tests of Price Reversal

These tests determine whether the positive price effect of option introductions is followed by a corresponding negative effect, prior to the expiration date of the first option contract. Two types of price reversal tests are performed:

i) An "overall" price reversal test, verifying whether the average listing is followed by an average negative price effect in the post-listing period. (The results of this test are shown in Table 3.)

ii) Cross-sectional tests of price reversal, verifying if stocks with the strongest positive listing price effect also experience the strongest post-listing price reversal. (Results for these tests are shown in Tables 4 and 8.)

Cross-Sectional Analysis of Price Effect and Share Turnover as a Function of Firm Size and Stock Volatility

Cross-sectional analysis is used to test the following joint hypothesis: (a) the pre-1980 positive listing price effect is due to stock price manipulation, and (b) stock price manipulation is more likely to occur for small stocks with large volatilities. Two types of cross-sectional tests are performed:

i) Regression analysis, where either the listing price effect, or the listing abnormal share turnover are regressed on firm size and stock volatility (Table 5).

ii) Quartile analysis, where the sample data is divided into quartiles, according to firm size and stock volatility. For each quartile, the average price effect and abnormal share turnover are computed, in order to test the hypothesis that market manipulation (as detected by price effect and turnover) is more likely to occur for small firms with large volatilities. (The results of the quartile analysis are presented in Table 7.)

Combined Cross-Sectional and Price Reversal Analysis

These tests allow for the interaction of the price reversal and cross-sectional tests described above. Two main hypotheses are tested:

i) Price reversal is more likely to occur for small stocks with large volatilities (Table 8); and

ii) The cross-sectional analysis described in the previous paragraph is more significant for stocks which experience price reversal (Table 6).

Abnormal Returns Estimation

To estimate the price effect of option introduction, I use both Cumulative Abnormal Returns (CAR) and Cumulative Raw Returns (CRR), calculated over both listing and post-listing windows. The following variables are used throughout Tables 3 to 8:

CAR: The cumulative abnormal returns computed using the Brown and Warner (1985) market model, with parameters estimated over the 95 trading days preceding the beginning of the listing window. CARs are calculated for both the listing window, and the post-listing window prior to the expiration date of the first option contract.

CRR: The cumulative raw returns calculated for the listing and post-listing windows.

Listing window: The 10-day period extending from L-5 to L+5, where L is the option listing date.

Post-listing window: Alternatively, the period extending from day L+6 to day E, and the period extending from day E-40 to day E, where E is the expiration date of the first option contract.

Firm size: The market capitalization of a firm's outstanding equity, adjusted for inflation using the 1983 price level. Market capitalization is computed as the product of share price and outstanding shares, averaged over the event window.

Stock volatility: The standard deviation of raw returns, computed over the period ranging from L-100 to L-6.

Abnormal share turnover: The difference between the mean share turnover computed over the [L-5 to L+5] period, and the mean share turnover computed over the [L-100 to L-6] period. Share turnover is estimated as the mean dollar volume of trade divided by the stock's market capitalization (in \$).

Evidence of Stock Price Manipulation.

Figures 2, 3 and 4 present preliminary, prima facie evidence of stock price manipulation, by showing that the positive post-1980 price effect does not persist over the 50 trading days following listing dates. In Figure 2, cumulative abnormal returns are plotted for the 200 trading days around the listing event (100 on each side), using all stocks which became optioned between 1973 and 1980. While impressive CARs are evident in the narrow event window, they quickly vanish over the following 50 trading days, the average lifetime of the first option contract (during that time period). A formal statistical test confirms these conclusions: whereas the cumulative price event at the end of the 10-day listing window is strongly positive (CAR=2.47%, $t=4.66$), the price effect drops to virtually zero by the 50^{th} trading day after listing (CAR=0.02%, $t=0.01$).[6]

Figure 3 depicts cumulative raw returns for the same period. Again, the price pattern is consistent with an impressive price run-up during the event window, followed by a period of stagnation leading to the expiration of the first option contract.

By contrast, no evidence of market manipulation is observed when post-1980 events are used: in Figure 4 cumulative abnormal returns are plotted for all stocks which

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[6] This finding contrasts with the implicit conclusion deriving from Conrad (1989). Using the results of her Table I, one could conclude that the positive price effect is permanent. However, Conrad's Table I only presents results for up to 30 days after listing, during which the price effect remains positive. I find similar positive persistence over the same 30-day interval (CAR=1.86%, $t=2.27$). However, as reported above, the CARs totally vanish during the following 20 days. This 50-day price reversal is consistent with the conjecture that stock prices return to their normal level prior to the expiration date of their first option contract (which, on average, equals 50 days during that period). .

became optioned between 1981 and 1992. Unlike Figure 2, event-window CARs are negative, and persistent over at the 100-day period after listing (CAR=-11.50%, *t=-8.27*).[7] This finding suggests that a change in equilibrium stock prices occurs after option introductions, during the 1981-1992 period.

A first formal test of price reversal is presented in Table 3, which compares pre-1980 stock performance across three different windows: (i) listing event, (ii) post-listing event, extending to the expiration date of the first option contract, and (iii) cumulative "holding period," composed of (i) and (ii).

The first row in Table 3 confirms that substantial price increases occur during the listing event window, as illustrated in Figures 1, 2 and 3. The second row shows that the average listing is followed by a negative abnormal performance, for the period extending to the expiration date of the option contract. For each row, the conclusion holds when both raw and abnormal returns are used to estimate price effects.

More interesting are the results shown in the last row: between 1973 and 1980, if an investor chose to purchase an optioned stock five trading days before listing, and held it until the expiration date of the first option contract, it would not have realized any gains. This is consistent with the event-window price effect being only temporary, reflecting manipulative maneuvers by option dealers.

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[7] The graph in Figure 4 shows a slightly different cumulative price effect at day L+100: approximately -14%, compared to the -11.5% reported. The difference is that Figure 4 uses abnormal returns of individual stocks, whereas the statistical result reported in the text is based on portfolios of stock grouped by listing date.

Table 4 relates listing period returns and abnormal turnovers to stock price reversals. One implication of the market manipulation hypothesis is that stocks which are being manipulated experience negative returns close to the expiration date of their first option contract. Consequently, a good proxy for whether or not a particular stock is being manipulated is the sign of the stock's cumulative returns, close to the expiration date of the first option contract. That is, stocks with negative near-expiration returns are more likely to have been manipulated around option listing. Table 4 therefore splits the stocks into two sub-samples, according to the sign of cumulative returns during the 40 days preceding the option expiration date. The target sub-sample of interest is the one where stocks have negative near-expiration returns. If the market manipulation hypothesis is correct, I expect listing-window price and turnover effects to be significantly higher in the target sub-sample compared to its counterpart. Table 4 presents therefore tests of the joint hypothesis that (1) listing period price and turnover effects are due to stock price manipulation, and (2) manipulated stocks have negative near-expiration returns.

Panel A of Table 4 shows that between 1973 and 1980, price effects and abnormal turnovers are generally higher for stocks experiencing subsequent price reversals, although the difference is statistically significant only in the case of cumulative raw returns. The first row in Panel A shows that CARs in the target sub-sample are 4.07%, compared to 2.60% in its counterpart. While target CARs are higher (as expected), the difference between the two groups is not statistically significant: ([CAR(target)-CAR(counterpart)] = 1.47%, *t=1.03*). A similar pattern is discernible for abnormal share turnover, which is larger in the target sub-sample without being statistically different: ([TURNOVER(target) - TURNOVER(counterpart)] = 1.79%, *t=1.26*). By contrast, cumulative raw returns are significantly higher in the target sub-sample: ([CRR(target)-CRR(counterpart)]=5.39%, *t=3.33*). Overall, the data in Panel A are moderately consistent with the market manipulation hypothesis.

Panel B repeats the analysis for options listed between 1981 and 1992. Unlike Panel A, no clear relationship is discernible between post listing performance and either (1) the listing price effect or (2) abnormal turnover, consistent with the conjecture that stock price manipulation substantially diminished during that period.

Table 5 uses cross-sectional regressions to test the joint hypothesis that (a) the pre-1980 positive price effect and abnormal share turnover are due to stock price manipulation, and (b) option dealers manipulate mostly small stocks with large volatilities. Panel A estimates the following six equations for the pre-moratorium period (1973-1980):

$$CAR(listing) = \alpha_1 + \beta_1\, LOG(CAP) + \varepsilon_1 \qquad (2)$$

$$CRR(listing) = \alpha_2 + \beta_2\, LOG(CAP) + \varepsilon_2 \qquad (3)$$

$$Abnormal\ Turnover = \alpha_3 + \beta_3\, LOG(CAP) + \varepsilon_3 \qquad (4)$$

$$CAR(listing) = \alpha_4 + \gamma_4\, SDR + \varepsilon_4 \qquad (5)$$

$$CRR(listing) = \alpha_5 + \gamma_5\, SDR + \varepsilon_5 \qquad (6)$$

$$Abnormal\ Turnover = \alpha_6 + \gamma_6\, SDR + \varepsilon_6 \qquad (7)$$

A significantly negative β_1 or β_2 indicates that the price effect of option introduction is strongest for smaller firms; likewise a significantly negative β_3 indicates that smaller stocks experience higher abnormal turnover during the event window. In sum, significantly negative β's are consistent with the hypothesis that manipulation is easier to achieve when only small stock quantities are required to move stock prices in the desired direction. The reverse is true for the γ coefficients, which must be significantly positive to be consistent with price manipulation, since more volatile stocks command higher call premia, making manipulation more attractive.

The results in Panel A are overwhelmingly consistent with market manipulation occurring between 1973 and 1980: the β coefficients are always significantly negative (at better than the 1% level in two of the three cases), while two of the three γ coefficients are significant at better than the 10% level. (The third coefficient--γ_5--is marginally significant, with p=.105.)[8]

Panel B of Table 5 estimates equations (2) through (7) for the period 1981-1992, when "good faith credit" and "free riding" were no longer permitted. None of the coefficients in the six cross-sectional regressions is significant, indicating that stock price manipulation substantially declined in the post-moratorium period.

Table 6 repeats the analysis of Table 5 for two sub-samples of the original data, selected according to the sign of the stock's post-listing performance. As in Table 4, I conjecture that cross-sectional regressions will be significant only in the case of the target sub-sample of stocks with negative near-expiration returns. This table in effect represents an interactive test of price reversal and cross-sectional analysis, used to strengthen the previous conclusions about stock price manipulation.

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[8] I have also estimated multivariate versions of equations (2) to (7), with LOG(CAP) and SDR as joint independent variables. While individual coefficients always carry the correct sign, they are generally insignificant due to the presence of multi-collinearity (the correlation coefficient between LOG(CAP) and SDR is -0.588). The overall F-statistic however, remains highly significant, suggesting that the two variables have a strong joint explanatory power.

Panel A of Table 6 presents the results for stocks experiencing negative near-expiration returns during the 1973-1980 period. As conjectured, the coefficient of the independent variable is strongly significant at better that the 1% level in the first five cases, and at the 5% level in the case of equation (7). These coefficients are generally more significant than the corresponding coefficients in Table 5. In Panel B of Table 6 the same six equations are estimated for stocks with positive post-listing performance. In sharp contrast with models estimated using the subsample of stocks with negative near-expiration returns, none of the regression coefficients are significant for this data subset.[9] Overall, this evidence suggests that the results in Table 5 are driven exclusively by the sub-sample of stocks with negative post-listing performance. That is, between 1973 and 1980, manipulation is only detected for stocks experiencing a post-listing price reversal.

Panels C and D of Table 6 present the results for the 1981-1992 period. As with previous tests, none of the regression coefficients are significant during that period, reinforcing the previous conclusion that federal regulators successfully prevented stock price manipulation from re-occurring after 1980.

Throughout Tables 5 and 6, standard errors are corrected using a White heteroskedasticity-consistent variance-covariance matrix. An alternative way to adjust for heteroskedasticity would be to use the inverse of the abnormal returns standard deviation as a weighting variable in an Ordinary Least Square (OLS) model. To assess the

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[9] A statistical comparison of the independent variable coefficients across the two panels reveals that these coefficients are statistically different only for the second ($t=1.89$) and fifth ($t=2.43$) equations estimated in Panels A and B. Nonetheless, the data in Panel A presents more significant regressions than that of Panel B, which is consistent with the conjecture that stocks with negative near-expiration returns are the ones that are being manipulated.

robustness of my results, I have repeated the analysis in Tables 5 and 6 by substituting the weighted least square (WLS) model for the White OLS model presented. When Tables 5 and 6 are repeated using WLS estimates, the market manipulation conclusions remain qualitatively identical: manipulation occurs mostly for small stocks with high volatility.[10]

Table 7 repeats the analysis of Table 5 to test the joint hypothesis that that (a) the pre-1980 positive price effect and abnormal share turnover are due to stock price manipulation, and (b) option dealers manipulate mostly small stocks with large volatilities. Unlike Table 5 which imposes a linear relationship between price effects and independent variables, the analysis presented in Table 7 consists of comparing price effects across the four different quartiles of each dependent variable. The advantage of this type of analysis is that no specific relationship is imposed between the dependent and independent variables. The cross-sectional regressions estimated in equations (2) through (7) necessarily impose a linear functional form for the relationships between (a) price effects or share turnover on the one hand, and (b) volatility or the logarithm of firm size on the other. When the exact functional form is unknown, the use of quartile analysis provides an alternative method to test the market manipulation hypothesis, and to assess the robustness of the results obtained in the cross-sectional regressions.

Panel A of Table 7 shows the results for all CBOE calls listed prior to the end of 1980. In the top part of the Panel, firm size is considered as a potential explanatory

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[10] In addition, WLS results tend to be more significant than the White-adjusted OLS results shown in Tables 5 (Panel A) and Table 6 (Panel A) For example, in the fifth regression of Panel A in Table 5, the coefficient of SDR is only marginally significant at the 10% level. In the WLS regression, that coefficient is significant at better than the 10% level ($t=1.80$).

variable for listing price and turnover effects. In accordance with previous findings, the explanatory power of firm size is very substantial: firms in the lowest quartile experience the highest positive price effect and abnormal share turnover. Moreover, the relation between price effect and firm size is monotonic, as predicted by the previously presented theoretical discussion. Of particular interest is the magnitude of the price effect for firms in this lowest size quartile: 7.5% using raw returns, and 6.7% using abnormal returns! By contrast, firms in the highest size quartile experience no significant price effect around the date of their option introduction, consistent with the hypothesis that option dealers do not attempt to manipulate the stock of some of the largest firms on the market.[11]

The middle part of Panel A considers the effects of return volatility on the listing price effect and abnormal share turnover. In general, the results are qualitatively consistent with the conclusions of Table 5: there is an increasing monotonic relation between price effects and volatilities, and in the case of cumulative abnormal returns, the price effect in the most volatile group (6.095%) is statistically different from the effect in the less volatile group (1.114%), with a t-statistic of *2.24*.[12] Unlike price effects, abnormal turnovers do not appear to be monotonically related to volatilities. Nonetheless, the difference between the first and fourth groups (3.847%) is marginally significant at the 15% level ($t=1.61$). Overall, the last row of the middle section indicates that the average price effect is driven

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[11] Using statistical tests of mean differences, I find that all three parameters estimated in the first group (small CAP) are significantly higher than those estimated in the fourth group (large CAP):

CRR(group 1) - CRR(group 4) = 6.242%, $t=2.18$;

CAR(group 1) - CAR(group 4) = 6.029%, $t=3.19$; and

ABNTURN(group 1) - ABNTURN(group 4) = 6.779%, $t=2.77$.

mostly by firms with large return volatility, for which price manipulation is more profitable.

The bottom part of Panel A considers the interactive effects between firm size and return volatilities on the one hand, and price and turnover effects on the other. The usual pattern is once again discernible: most of the listing price and turnover effects occur for small stocks with large volatilities.

Panel B repeats the quartile analysis for options listed after 1980. As with previous tests, no clear pattern is distinguishable during this period.

In short, Table 7 shows that the qualitative conclusions of Table 5 are robust to a plausible change in the model specification.

Table 8 presents a different analysis of the interaction between price reversal, firm size and stock volatilities. The following general model is estimated throughout the Table[13]:

$$CRR(list\ window) = \gamma_0 + \gamma_1\ CRR(exp40) + \varepsilon \qquad (8)$$

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[12] In the case of cumulative raw returns, this difference is insignificant.

[13] This table uses exclusively the cumulative raw returns as a measure of stock price performance. Comparing cumulative abnormal returns (CARs) estimated during the event window with the CARs estimated near the expiration date poses a serious econometrical problem: since both measures share the same estimated α (from the market model), they also share the same measurement error. Consequently, CAR(list window) and CAR(exp40) will always be positively correlated (by construction), regardless of the true, underlying economic relationship. That is, given any random sample of stocks and event dates, the two estimates will be positively correlated. As an alternative to using cumulative raw returns, I have considered estimating CAR(exp40) using the market model estimated in the L+100/L+200 period, and comparing it to CAR(list window) estimated over L-100/L-6. However, as explained in Chapter 6, stock returns during the L+100/L+200 period are affected by the introduction of options, which is likely to introduce considerable noise in the cross-sectional regression.

where a significantly negative γ_1 suggests that price reversal holds for every firm, in cross-section. That is, firms with highly positive listing price effects also experience highly negative post-listing performances. I estimate equation (8) for six sub-samples of my original data, selected according to listing date, optioned stock size, and optioned stock volatility.

Panel A presents the results for options listed prior to the end of 1980. The first row of Panel A shows that on average, the optioned stock experiences a price reversal in the post-listing period (the γ_1 coefficient is significantly negative at the 5% level). In the second row, equation (8) is estimated only for the subset of stocks with above-median market capitalization, and below-median return volatility. As conjectured, no price reversal is observed in this case. By contrast, the last row of Panel A presents strong evidence of price reversal when equation (8) is estimated only for the smaller stocks with higher volatilities.

The analysis is repeated in Panel B for options listed between 1981 and 1992, but no evidence of price reversal is found for any of the three samples examined.

Overall, the totality of the evidence presented in Tables 3 through 8 is strongly consistent with the following conclusions:

1. The positive price effect of option introduction documented between 1973 and 1980 may be explained by stock price manipulation.

2. During that period, option dealers have mostly manipulated smaller stocks (which required lesser capital "input" to the manipulation "technology"), and stocks with large volatilities (which commanded higher call premia).

3. The typically manipulated stock experienced a strong price increase during the listing window and a corresponding strong decrease during the post-listing window.

4. The price effect documented in Conrad (1989) is only temporary, and does not reflect a change in the asset's equilibrium price level.

5. The repeal of "free riding" at the end of 1980 has considerably increased the option dealers' costs of manipulating stock prices, substantially diminishing the appeal of stock price manipulation in recent years.

An Alternative Explanation

The market manipulation hypothesis is clearly consistent with the disappearance of the positive price effect after 1980. The only competing explanation encountered in the literature is found in Detemple and Jorion (1990), and is based on market completion. The authors attribute the disappearance of the positive price effect to the introduction of the index options in April 1982, which would have effectively "completed" the markets. If this hypothesis is correct, the positive price effect should have persisted through March 1982. However, when I analyze event-window abnormal returns for all listings occurring between January 1981 and March 1982, I find evidence of negative (rather than positive) CARs for that period (CAR = -2.03%, t= -2.062). The data are therefore inconsistent with this alternative explanation.

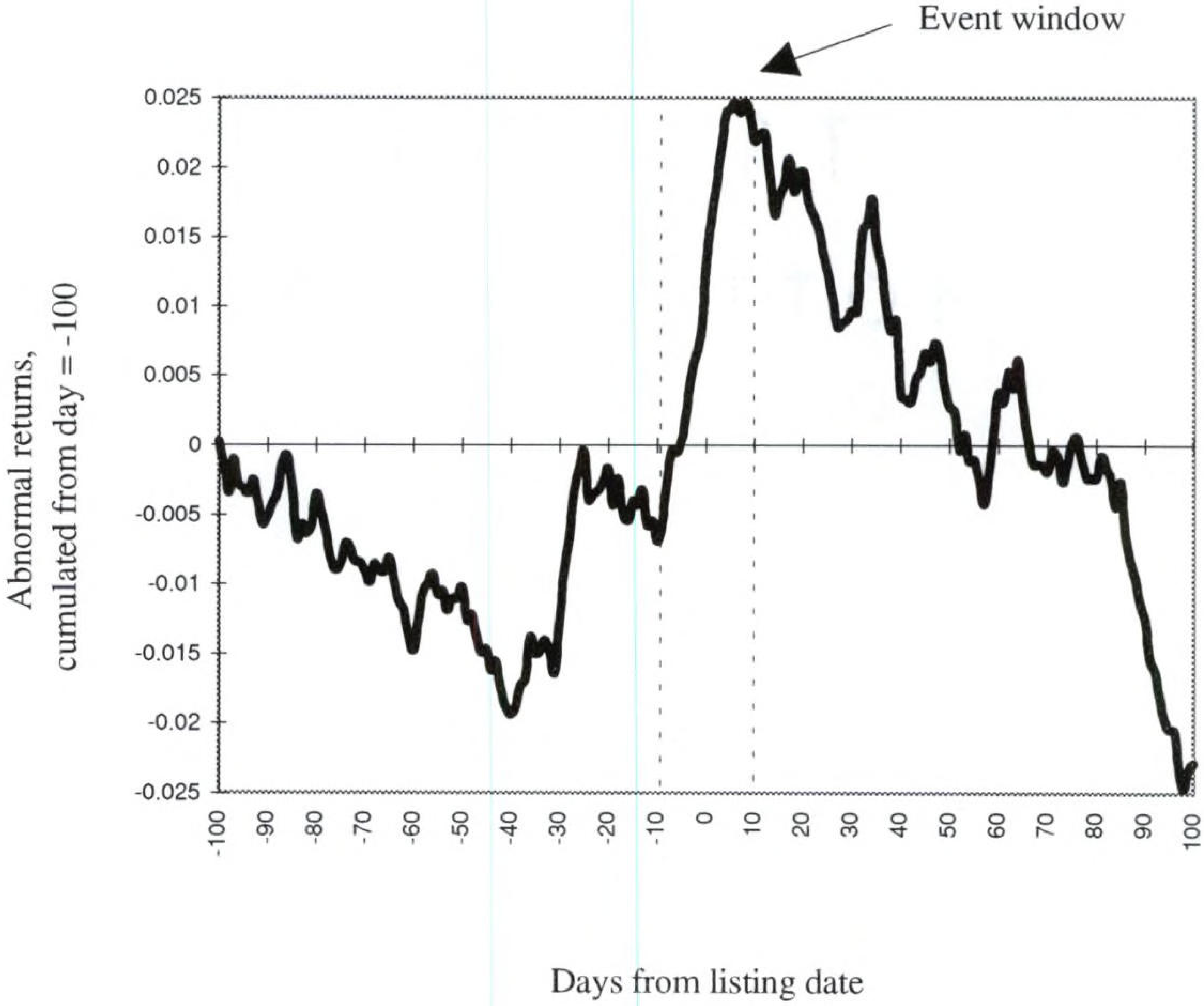

Figure 2:
Stock abnormal returns around option listings:
1973-1980

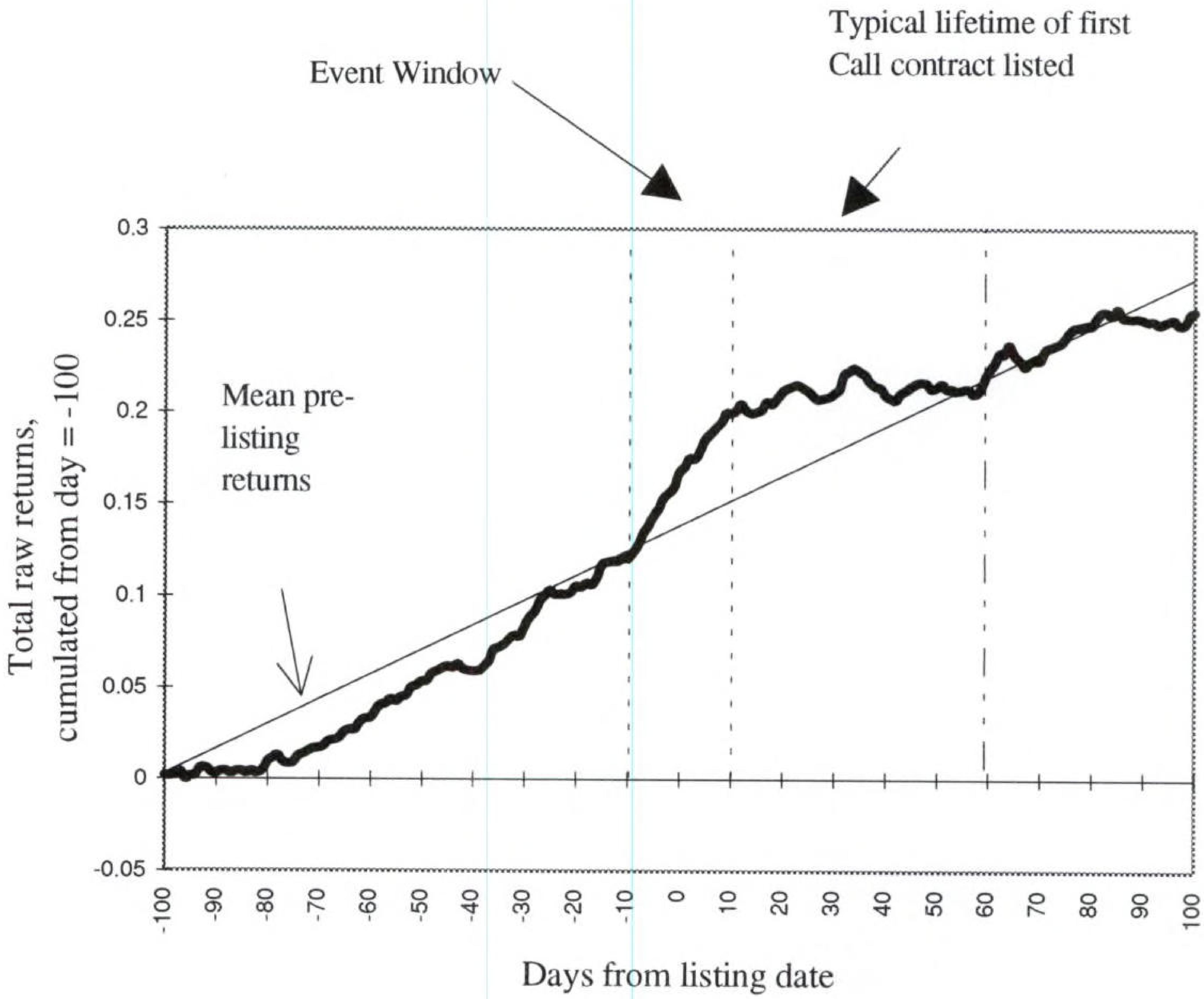

Figure 3:
Stock cummulative raw returns around opyion listings:
1973-1980

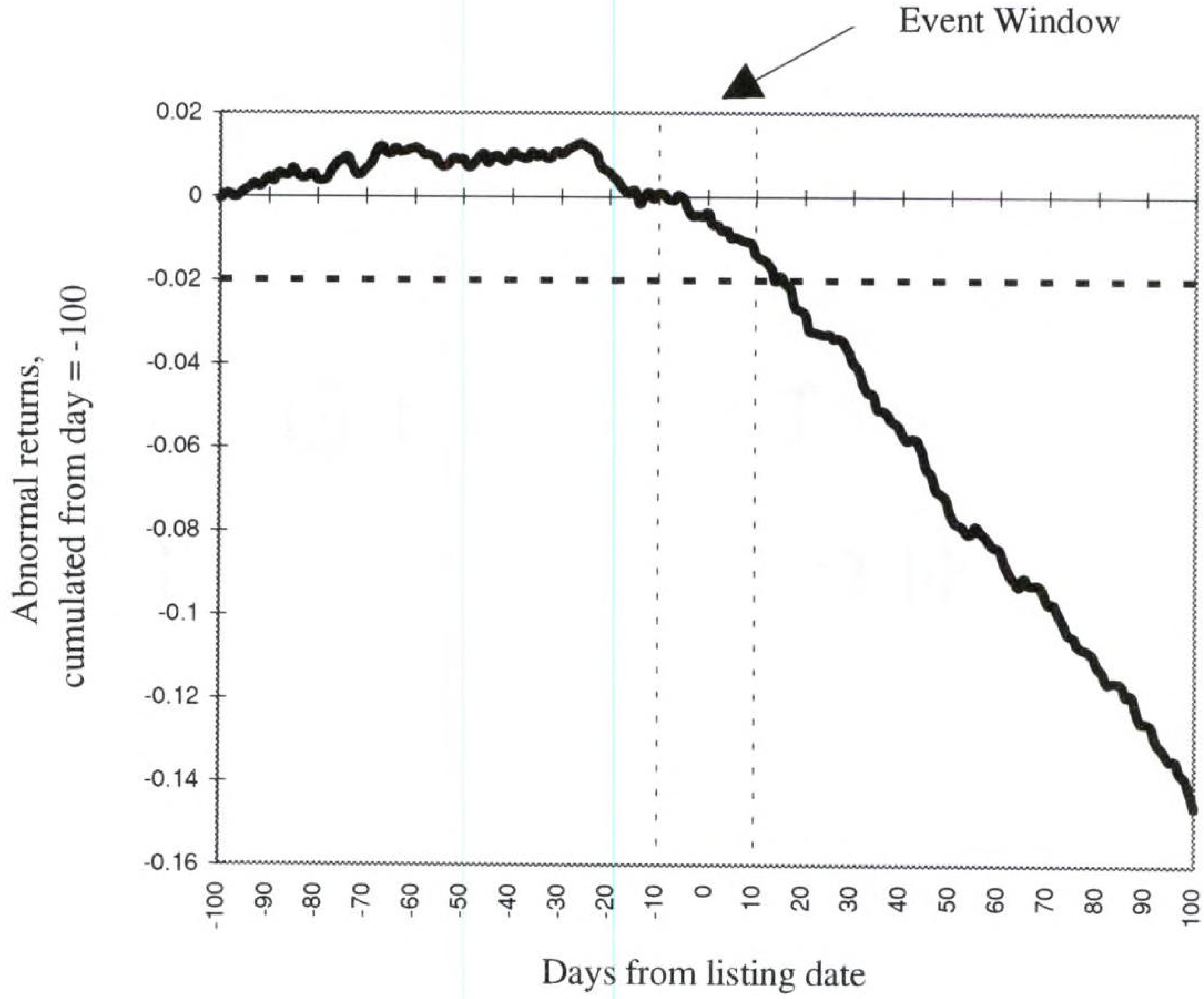

Figure 4:
Stock abnormal returns around option listings:
1981-1992

Table 3: Stock price behavior around listing and expiration dates of first Call option contracts listed on CBOE between 1973 and 1980.

Cumulative Abnormal Returns computed using the market model, estimated during the pre-listing (L-100/L-5) period.

Window	Cumulative Raw Returns	Cumulative Abnormal Returns
Listing window (N=78)	3.77% *(t=4.37)****	3.34% *(t=3.47)****
Post-listing window, leading to the expiration date of the first option contract (N=78)	-5.23% *(t=-2.57)***	-4.74% *(t=-2.08)***
Holding period, comprised of the previous two periods (N=78)	-1.46% *(t=-0.72)*	-1.40% *(t=-0.55)*

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Variable Definition:

- N : Number of stocks for which Call options were first listed on CBOE, during the time period indicated.

- Listing Window: Period extending from L-5 to L+5, where L represents the listing date.

- Post Listing Window: Period extending from L+6 to E, where E represents the expiration date.

- Holding Period: Period extending from L-5 to E.

Table 4: Listing returns, abnormal turnover, and price reversal.

This table relates listing period returns and abnormal turnover to stock price reversal. The table tests the joint hypothesis that (1) listing period price effects and abnormal turnovers are due to stock price manipulation and (2) manipulated stocks experience price reversal in the post-listing period.

Panel A: CBOE call options listed between 1973 and 1980

Stocks With Negative Expiration-Period Returns (CRR(exp40)<0) N=39			Stocks With Positive Expiration-Period Returns (CRR(exp40)>0) N=39		
Variable Name	Mean Value	T-statistic	Variable Name	Mean Value	T-statistic
CAR (list window)	0.0407	*3.514****	CAR (list window)	0.0260	*3.126****
CRR (list window)	0.0646	*6.053****	CRR (list window	0.0107	*0.879*
Abnormal turnover	0.0243	*2.635***	Abnormal turnover	0.0064	*0.599*

Panel B: CBOE call options listed between 1981 and 1992

Stocks With Negative Expiration-Period Returns (CRR(exp40)<0) N=47			Stocks With Positive Expiration-Period Returns (CRR(exp40)>0) N=53		
Variable Name	Mean Value	T-statistic	Variable Name	Mean Value	T-statistic
CAR (list window)	-0.010	*-0.917*	CAR (list window)	-0.007	*-0.621*
CRR (list window)	0.011	*0.916*	CRR (list window)	0.013	*1.156*
Abnormal turnover	0.021	*1.606*	Abnormal turnover	0.004	*0.203*

Table 4. Continued

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Variable Definitions:

- CAR: Cumulative Abnormal Returns, computed for the period indicated in brackets. Abnormal returns are calculated using the Brown and Warner (1985) market model, estimated from L-100 to L-6, where L represents the listing date.

- CRR: Cumulative Raw Returns, computed for the period indicated in brackets.

- Abnormal Turnover: The difference between the mean share turnover computed during L-5 to L+5, and the mean share turnover computed during L-100 to L-6. Share turnover is estimated as the volume of trade divided by the stock's market capitalization.

- (list window): Period extending from L-5 to L+5.

- (exp40): Period extending from E-40 to E, where E represents the expiration date.

Table 5: Cross-sectional regressions between listing period returns and abnormal share turnover (dependent variables) and two proxies for stock price manipulation: firm size and stock volatility (independent variables).

This table is a test of the following joint hypothesis: (1) the listing period price effect and abnormal turnover are due to stock price manipulation, and (2) option dealers manipulate mostly small stocks, with large standard deviation. Standard errors are computed using a White heteroskedasticity consistent variance-covariance matrix.

Panel A: CBOE call options listed between 1973 and 1980

Dep. Variable	Indep. Variable	Constant Coeff.	Constant T-stat.	Indep. Var. Coeff.	Indep. Var. T-stat.	N. Obs.	Adj. R^2
CAR (list window)	LOG(CAP)	0.189	3.114***	-0.015	-2.699***	78	0.0855
CRR (list window)	LOG(CAP)	0.178	2.154**	-0.014	-1.820*	78	0.0421
Abn. Turnover	LOG(CAP)	0.190	2.684***	-0.017	-2.681***	77	0.1152
CAR (list window)	SDR	-0.032	-1.499	2.844	2.706***	78	0.0907
CRR (list window)	SDR	-0.008	-0.356	2.011	1.644[Δ]	78	0.0224
Abn. Turnover	SDR	-0.033	-1.570	2.123	1.861*	77	0.0451

Table 5. Continued

Panel B: CBOE call options listed between 1981 and 1992

Dep. Variable	Indep. Variable	Constant Coeff.	Constant T-stat.	Indep. Var. Coeff.	Indep. Var. T-stat.	N. Obs.	Adj. R^2
CAR (list window)	LOG(CAP)	-0.035	*-0.537*	0.003	*0.435*	101	-0.0081
CRR (list window)	LOG(CAP)	0.0727	*0.957*	-0.006	*-0.814*	101	-0.0013
Abn. Turnover	LOG(CAP)	0.0403	*0.201*	-0.0031	*-0.144*	100	-0.0096
CAR (list window)	SDR	-0.0189	*-0.971*	0.377	*0.504*	101	-0.0075
CRR (list window)	SDR	0.0047	*0.249*	0.290	*0.387*	101	-0.0086
Abn. Turnover	SDR	0.0310	*0.781*	-0.643	*-0.374*	100	-0.0072

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level
Δ Marginally significant at the 10% level (p=0.105, two-tail test)

Table 5. Continued

Variable Definitions:

- CAR: Cumulative Abnormal Returns, computed for the period indicated in brackets. Abnormal returns are calculated using the Brown and Warner (1985) market model, estimated from L-100 to L-6, where L represents the listing date.

- CRR: Cumulative Raw Returns, computed for the period indicated in brackets.

- CAP: The inflation-adjusted market capitalization, equal to the number of outstanding shares times the average share price during the event window. Figures are converted in 1983 constant dollars.

- LOG(CAP): The natural logarithm of CAP.

- SDR: The standard deviation of raw returns, computed over the pre-listing period. The pre-listing period extends from L-100 to L-6.

- Abn. Turnover: The difference between the mean share turnover computed during L-5 to L+5, and the mean share turnover computed during L-100 to L-6. Share turnover is estimated as the volume of trade divided by the stock's market capitalization.

- (list window): Period extending from L-5 to L+5.

Table 6: The relation between abnormal returns, turnover, firm size, return volatility, and price reversal

This table presents a test of the following joint hypothesis: (1) the listing period price effect and abnormal turnover are due to stock price manipulation, and (2) option dealers manipulate mostly small stocks, with large standard deviation, and (3) stocks whose prices are manipulated experience price reversal in the post listing period. Standard errors are computed using a White heteroskedasticity consistent variance-covariance matrix.

Panel A: CBOE call options listed between 1973 and 1980
Stocks with negative expiration period returns (CRR(exp40)<0)

Dep. Variable	Indep. Variable	Constant Coeff.	Constant T-stat.	Indep. Var. Coeff.	Indep. Var. T-stat.	N. Obs.	Adj. R^2
CAR (list window)	LOG(CAP)	0.237	*2.704***	-0.019	*-2.303***	39	0.1057
CRR (list window)	LOG(CAP)	0.317	*3.881****	-0.025	*-3.098****	39	0.2291
Abn. Turnover	LOG(CAP)	0.214	*3.296****	-0.018	*-3.174****	39	0.1675
CAR (list window)	SDR	-0.062	*-1.951**	4.333	*2.804****	39	0.1538
CRR (list window)	SDR	-0.045	*-1.734**	4.628	*4.451****	39	0.2158
Abn. Turnover	SDR	-0.037	*-1.469*	2.621	*2.166***	39	0.0770

Table 6. Continued

Panel B: CBOE call options listed between 1973 and 1980
Stocks with positive expiration period returns (CRR(exp40)>0)

Dep. Variable	Indep. Variable	Constant Coeff.	Constant T-stat.	Indep. Var. Coeff.	Indep. Var. T-stat.	N. Obs.	Adj. R^2
CAR (list window)	LOG(CAP)	0.120	*1.204*	-0.009	*-0.986*	39	0.0196
CRR (list window)	LOG(CAP)	-0.057	*-0.363*	0.006	*0.457*	39	-0.0155
Abn. Turnover	LOG(CAP)	0.147	*0.929*	-0.013	*-0.949*	38	0.0379
CAR (list window)	SDR	-0.003	*-0.129*	1.138	*0.969*	39	0.0073
CRR (list window)	SDR	0.0340	*0.845*	-1.037	*-0.497*	39	-0.0170
Abn. Turnover	SDR	-0.0273	*-0.773*	1.481	*0.745*	38	-0.0014

Table 6. Continued

Panel C: CBOE call options listed between 1981 and 1992
Stocks with negative expiration period returns (CRR(exp40)<0)

Dep. Variable	Indep. Variable	Constant Coeff.	Constant T-stat.	Indep. Var. Coeff.	Indep. Var. T-stat.	N. Obs.	Adj. R^2
CAR (list window)	LOG(CAP)	-0.061	*-0.587*	0.005	*0.486*	47	-0.0160
CRR (list window)	LOG(CAP)	0.088	*0.608*	-0.008	*-0.526*	47	-0.0100
Abn. Turnover	LOG(CAP)	0.0557	*0.431*	-0.004	*-0.287*	46	-0.0212
CAR (list window)	SDR	0.007	*0.031*	-0.414	*-0.502*	47	-0.0198
CRR (list window)	SDR	0.006	*0.185*	0.177	*0.122*	47	-0.0218
Abn. Turnover	SDR	0.016	*0.547*	0.139	*0.106*	46	-0.0225

Table 6. Continued

Panel D: CBOE call options listed between 1981 and 1992
Stocks with positive expiration period returns (CRR(exp40)>0)

Dep. Variable	Indep. Variable	Constant Coeff.	Constant T-stat.	Indep. Var. Coeff.	Indep. Var. T-stat.	N. Obs.	Adj. R^2
CAR (list window)	LOG(CAP)	-0.016	*-0.182*	0.001	*0.114*	53	-0.0193
CRR (list window)	LOG(CAP)	0.069	*0.721*	-0.006	*-0.632*	53	-0.0108
Abn. Turnover	LOG(CAP)	0.0539	*0.187*	-0.005	*-0.184*	53	-0.0177
CAR (list window)	SDR	-0.0290	*-1.111*	-0.769	*-0.716*	53	-0.0063
CRR (list window)	SDR	-0.0028	*0.124*	0.352	*0.388*	53	-0.0167
Abn. Turnover	SDR	0.0321	*0.592*	-0.954	*-0.392*	53	-0.0140

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table 6. Continued

Variable Definitions:

- CAR: Cumulative Abnormal Returns, computed for the period indicated in brackets. Abnormal returns are calculated using the Brown and Warner (1985) market model, estimated from L-100 to L-6, where L represents the listing date.

- CRR: Cumulative Raw Returns, computed for the period indicated in brackets.

- CAP: The inflation-adjusted market capitalization, equal to the number of outstanding shares times the average share price during the event window. Figures are converted in 1983 constant dollars.

- LOG(CAP): The natural logarithm of CAP.

- SDR: The standard deviation of raw returns, computed over the pre-listing period. The pre-listing period extends from L-100 to L-6.

- Abn. Turnover: The difference between the mean share turnover computed during L-5 to L+5, and the mean share turnover computed during L-100 to L-6. Share turnover is estimated as the volume of trade divided by the stock's market capitalization.

- (list window): Period extending from L-5 to L+5.

- (exp40): Period extending from E-40 to E, where E represents the expiration date.

Table 7: Quartile analysis of the relations between (1) listing period returns and share turnover and (2) firm size and stock volatility.

Like Table 4, this is a test of the following joint hypothesis: (1) the listing period price effect and abnormal turnover are due to stock price manipulation, and (2) option dealers manipulate mostly small stocks, with large standard deviation. T-statistics are shown in brackets below each entry.

Panel A: CBOE call options listed between 1973 and 1980

Independent Variable	Quartile	CRR (list window) (%)	CAR (list window) (%)	Abn. Turnover (%)
CAP	1 (lowest)	7.503	6.727	6.751
	(N=19)	*(2.810)***	*(4.064)****	*(2.758)***
	2	3.202	3.573	-0.573
	(N=20)	*(2.094)***	*(2.057)**	*(-0.734)*
	3	3.158	2.393	0.162
	(N=20)	*(3.229)****	*(2.605)***	*(0.868)*
	4 (highest)	1.261	0.698	-0.028
	(N=19)	*(1.222)*	*(0.762)*	*(-0.508)*
SDR	1 (lowest)	2.188	1.114	0.427
	(N=19)	*(2.103)***	*(1.337)*	*(2.538)***
	2	3.380	2.433	0.329
	(N=20)	*(2.108)***	*(1.853)**	*(0.444)*
	3	3.763	3.714	1.193
	(N=20)	*(2.988)****	*(3.435)****	*(0.954)*
	4 (highest)	5.573	6.095	4.274
	(N=19)	*(2.182)***	*(2.952)****	*(1.797)**
High CAP and low SDR		2.449	1.421	0.123
(N=29)		*(2.882)****	*(1.864)**	*(0.996)*
Low CAP and high SDR		5.809	5.868	3.655
(N=29)		*(3.173)****	*(4.075)****	*(2.076)***

Table 7. Continued

Panel B: CBOE call options listed between 1981 and 1992

Independent Variable	Quartile	CRR (list window) (%)	CAR (list window) (%)	Abn. Turnover (%)
CAP	1 (lowest) (N=25)	2.784 *(1.215)*	0.744 *(-0.322)*	3.348 *(0.733)*
	2 (N=26)	3.903 *(2.990)****	1.129 *(0.938)*	-0.112 *(-0.059)*
	3 (N=25)	-1.802 *(-1.021)*	-3.419 *(-2.072)*	1.939 *(1.270)*
	4 (highest) (N=25)	0.199 *(0.230)*	-0.349 *(-0.386)*	-0.0389 *(-0.045)*
SDR	1 (lowest) (N=25)	1.317 *(1.384)*	-0.318 *(-0.372)*	-0.278 *(-0.352)*
	2 (N=26)	-0.328 *(-0.254)*	-2.691 *(-1.876)**	0.0527 *(0.071)*
	3 (N=25)	2.722 *(1.337)*	-0.283 *(-0.148)*	4.880 *(1.995)**
	4 (highest) (N=25)	1.543 *(0.706)*	0.062 *(0.031)*	0.471 *(0.105)*
High CAP and low SDR (N=36)		-0.085 *(-0.093)*	-1.788 *(-1.749)**	-0.222 *(-0.351)*
Low CAP and high SDR (N=36)		3.990 *(2.345)***	0.675 *(0.396)*	2.185 *(0.641)*

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table 7. Continued

Variable Definitions:

- CAR: Cumulative Abnormal Returns, computed for the period indicated in brackets. Abnormal returns are calculated using the Brown and Warner (1985) market model, estimated from L-100 to L-6, where L represents the listing date.

- CRR: Cumulative Raw Returns, computed for the period indicated in brackets.

- CAP: The inflation-adjusted market capitalization, equal to the number of outstanding shares times the average share price during the event window. Figures are converted in 1983 constant dollars.

- LOG(CAP): The natural logarithm of CAP.

- SDR: The standard deviation of raw returns, computed over the pre-listing period. The pre-listing period extends from L-100 to L-6.

- Abn. Turnover: The difference between the mean share turnover computed during L-5 to L+5, and the mean share turnover computed during L-100 to L-6. Share turnover is estimated as the volume of trade divided by the stock's market capitalization.

- (list window): Period extending from L-5 to L+5.

Note:

In the bottom part of Panels A and B, the first group consists of stocks with above-median market capitalization and below-median volatility. The second group consists of stocks with below-median market capitalization and above-median volatilities.

Table 8: Evidence of price reversal

This table presents cross-sectional regressions of listing period returns on post-listing returns, to determine whether price reversal holds in cross-section. The model estimated is of the following form:

$$CRR(list\ window) = \alpha + \beta\ CRR(exp40) + \varepsilon$$

The values of α and β are shown in the table. Standard errors are computed using a White heteroskedasticity consistent variance-covariance matrix.

Panel A: CBOE call options listed between 1973 and 1980

Sample Selection	α	T-stat. of α	β	T-stat. of β	N. Obs	Adjusted R^2
All call listings	0.0358	*4.201****	-6.210	*-2.523***	78	0.0889
Large stocks with low volatility	0.0244	*2.824****	0.036	*0.0125*	29	-0.0370
Small stocks with high volatility	0.0548	*3.089****	-9.368	*-2.155***	29	0.1700

Panel B: CBOE call options listed between 1981 and 1992

Sample Selection	α	T-stat. of α	β	T-stat. of β	N. Obs	Adjusted R^2
All call listings	0.0129	*1.540*	0.236	*0.153*	101	-0.0100
Large stocks with low volatility	-0.0009	*-0.102*	1.088	*0.498*	36	-0.0235
Small stocks with high volatility	0.0409	*2.435***	-0.866	*-0.394*	36	-0.0270

Table 8. Continued

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Variable Definitions:

- CAR: Cumulative Abnormal Returns, computed for the period indicated in brackets. Abnormal returns are calculated using the Brown and Warner (1985) market model, estimated from L-100 to L-6, where L represents the listing date.

- CRR: Cumulative Raw Returns, computed for the period indicated in brackets.

- CAP: The inflation-adjusted market capitalization, equal to the number of outstanding shares times the average share price during the event window. Figures are converted in 1983 constant dollars.

- LOG(CAP): The natural logarithm of CAP.

- SDR: The standard deviation of raw returns, computed over the pre-listing period. The pre-listing period extends from L-100 to L-6.

- (list window): Period extending from L-5 to L+5.

- (exp40): Period extending from E-40 to E, where E represents the expiration date.

CHAPTER 6
THE SELECTION BIAS HYPOTHESIS

Introduction

While the market manipulation hypothesis presented in Chapters 4 and 5 is consistent with the pre-1980 positive price effect, it does not account for the negative price effect observed after 1980. That is, after manipulation ceases, it is not clear why the price effect of option introductions becomes negative after 1980, and appears to persist over the 100-day period following the listing.

In an attempt to identify the cause of this negative price effect, I must first determine whether the observed abnormal returns reflect a "true" change in equilibrium stock prices, or whether they merely reflect a bias in the process by which exchanges select optionable stocks.

This chapter identifies two selection bias hypotheses. The first is a "price threshold" hypothesis, according to which exchanges select mostly stocks which have just met the minimum price-per-share criterion required in order to become optionable. The second is an "over performance" hypothesis, which states that exchanges select mostly stocks which have over-performed the market in the immediate period preceding the option listing.

The data do not however support either one of these two hypotheses, leaving wide open the possibility that the negative price effect may indeed represent a permanent change in the equilibrium prices of underlying stocks.

The "Price Threshold" Hypothesis

One possible explanation for the post-1980 negative price effect lies in the way in which stocks are selected for option listings. While the ultimate listing decision belongs to the options exchange (and is entirely driven by profit considerations), SEC regulations impose minimal criteria which must be met by all stocks before they become eligible for options trading. Among these criteria is the share price of the underlying stock, which must remain above a certain threshold level during the three calendar months prior to the listing of its first option contract. For most of my sample period (1973-1988), this threshold price was $10 per share, during each of the 60 days prior to the listing date. SEC regulations introduced in 1988 lowered this threshold to an average price of $7.50 per share, computed over the 60-day period prior to listing. In either cases the option may remain listed as long as the stock trades above $5 per share.

Under these circumstances, one must inquire whether the post-1980 negative price effect is not mostly driven by stocks which became optioned as soon as they met the price threshold criterion. In such case, the sample of stocks used in this dissertation would have an upwards-biased pre-listing performance, resulting in an over-estimate of the constant term (α) in the market model. With an over-estimated α, abnormal returns calculated during an otherwise normal period would appear to be negative. This would then create the appearance of negative abnormal returns in the post-listing period, even if the stock performance during that period were normal.

One way to test the "price threshold" hypothesis is to identify a target sub-sample of underlying stocks, which had met the price threshold criterion long before they became optioned. (For example, Netscape stock was trading at $70 when its option became listed, well above the $7.50 minimum threshold level.) Members of this target sub-sample are therefore stocks for which the option listing decision was driven by considerations other than the minimum threshold criterion. Then, if members of the target sub-sample also experience a negative price effect in the post-1980 period, the "price threshold" hypothesis is refuted.

I have included in the target sub-sample all stocks which have constantly traded at over $12 per share during the 120 days preceding the listing. Thus, all members of the target sub-sample became eligible for listing <u>at least</u> 60 days before their actual listing date. Clearly, if the target sub-sample represents a large proportion of the overall sample, the "price threshold" hypothesis is not likely to be supported.

Table 9 presents descriptive statistics about the relative size of the target sub-sample: between 1981 and 1992, 91.3% of all options listed were related to stocks which had been trading at a price greater than $12 per share for at least 120 days. That is, like Netscape, 91.3% of the stocks <u>did not</u> become optioned <u>immediately</u> after they met the minimum criterion, but rather at some distant time in the future.

I have also repeated the analysis in Table 2, Panels A, B and C, using only stocks which are member of the target sub-sample. The results are qualitatively identical to those of Table 2:[1] the price effect of the target sub-sample is positive prior to 1980, and becomes negative thereafter. Considering that a relatively large number of stocks became optioned long after they first met the price-threshold criterion, the negative price effect of option introductions appears to be unrelated to the price threshold hypothesis.

The "Over-Performance" Hypothesis

Even if no evidence of price-threshold selection bias is detected, a different type of selection bias is also possible, and warrants further consideration. Some early authors (e.g. Branch and Finnerty (1981) suggest that exchanges select mostly stocks which have over-performed the market in the 60 calendar days prior to the option introduction. Given this type of selection mechanism, one could argue that the negative event-window stock performance merely reflects the return to a more "normal" state of nature.

There are three factors, however, which considerably reduce the power of this argument: First, Skinner (1989) finds no evidence of any selection bias, for all options listed between 1973 and 1986. Second, this hypothesis does not fairly represent the exchange's selection incentives. The exchange profits rise with option volume, not with past stock performance. Option volume itself is closely dependent on stock volatility (not price) and to some extent the industry in which the firm trades.[2] Thus, if selection bias

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[1] Repeating the analysis in Table 2 for the target sub-sample yields results which are identical to the same degree of significance of the t-statistics. The few observations which account for the difference between the full and the target sample are evenly distributed in time, across listing events. When forming portfolios of stocks grouped by listing dates, the number of listing events remains unchanged, and the value of the estimated coefficients differs only by one significant digit in most cases.

[2] CBOE traders have indicated that whereas volatility is a major factor in the listing decision, many low-volatility firms also get listed, in order to offer a better cross-section of industries to the general investor.

existed, it would have to be related to stock volatility as opposed to mean returns, but Skinner also dismisses the presence of a volatility bias.

Third, even if exchanges really were to select better-than-average past performers, there is no particular reason for which these firms will cease to be better-than-average precisely on the day on which they become listed. Indeed, a close examination of Figure 4 shows that the change in the underlying stock price occurs inside the event window, rather than at some point in the future.[3]

I therefore conjecture that the observed post-1980 negative price effect is not consistent with the "Over-Performance" selection bias hypothesis. To test this assertion, I estimate the market model over two periods different from the one used in Chapters 3 and 5:[4]

- L-200 to L-100 (Model A); and
- L+100 to L+200 (Model B).

I then repeat the relevant tests from Chapters 3 and 5 using each of the two newly estimated market models.

If my conjecture is correct, I expect results estimated using Model A to be very similar to those obtained in Chapters 3 and 5: positive price-effects prior to 1980, negative price effects thereafter.

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[3] One explanation for the return to a "more normal" performance after listing would be to assume that stock prices follow a mean reversion process, with an approximately 100-day cycle. Thus, if a stock has over-performed for the past 100 days, it will more likely under-perform for the next 100-day period. Academic evidence on mean reversion processes is however inconclusive, thereby substantially reducing the appeal of this plausible explanation.

[4] In these models, L denotes the listing date.

More difficult is the interpretation of results obtained from model B. If this model's estimation period (L+100/L+200) is itself affected by the introduction of options, failure to find a negative listing price effect does not necessarily support the selection bias hypothesis. To illustrate this point, consider the following scenario: stock XYZ yields an average return of 10% per year for the 200 trading days prior to listing. Subsequently, its average rate of return drops to 7% and remains at that level for 200 trading days after the listing. The change occurs on day L. Then, by estimating the market model over either the L-200/L-100 period, or the L-100/L-5 period, one would find a negative price effect during the listing window. By contrast, when the market model is estimated over the L+100/L+200 period, the price effect inside the listing window will no longer be negative, since the estimation period is itself affected by the introduction of options.

Consequently, in order to better interpret the post-1980 results obtained from Model B, I must first determine if the post-listing period (L+100/L+200) has been significantly affected by the introduction of options. This can be achieved by calculating abnormal returns for the entire L+100/L+200 period, with respect to either one of the two pre-listing market models. If these abnormal returns are significantly negative, it is plausible to conclude that options have affected the rate of return of underlying stocks for at least 200 trading days after listing. In this case the absence of event-window abnormal returns obtained using model B <u>cannot</u> be interpreted as an indication of a selection bias.

In Table 10 below, I repeat the relevant part of the analysis presented in Chapter 3, with a market model estimated during the L-200 to L-100 period. As with the analysis presented in Table 2, I first form portfolios of stocks listed at the same date, and treat them as single securities. Similar to the results obtained in Table 2, I find that the price effect of option introductions remains significantly positive during the 1973-1980 period, and becomes significantly negative after 1981.

In the first part of Table 10 I show that pre-1980 results are qualitatively identical to those obtained in Table 2: the positive price effect of option introduction is about 2%, with a t-statistic significant at better than the 1% level. The second part of Table 10 shows that the post-1980 price effect is even more negative than the one computed in Table 2: the entire sample experiences listing abnormal returns equal to -1.18%, with a t-statistic of -3.204. This compares to the more modest -1.03% (t=-2.38) negative abnormal return computed using the market model estimated in Table 2. Lastly, the analysis in Table 10 reveals that the negative post-1980 abnormal returns are driven especially by joint put/call listings, and are more pronounced for stocks listed on the NASDAQ exchange.

Table 11 repeats the analysis presented in Table 10, for a market model estimated over the L+100/L+200 period. As with results from Tables 2 and 10, I find significant positive listing abnormal returns for stocks optioned during 1973-1980, which are consistent with market manipulation occurring during that period.

As earlier conjectured, no evidence of negative price effect is detected for the 1981-1992 period: all estimated abnormal returns are not significantly different from zero. In order to better interpret this finding, I must also determine whether stock returns over the L+100/L+200 estimation period have also been negatively affected by the option listing.

Table 12 shows abnormal returns for two different extended post-listing periods, using market models computed in two different pre-listing periods. The bottom half of Table 12 shows the results for the 1981-1992 period: as conjectured, abnormal returns in the extended post-listing periods are substantially negative, both statistically and economically: cumulative abnormal returns range from -9.82% to -13.33%, with t-statistics significant at better than the 0.1% level. These results suggest that the listing of an option significantly reduces the rate of return on the underlying stock for at least 200 trading days after listing occurs. Consequently, since returns over the L+100/L+200 period are also affected by the introduction of options, they cannot be reliably used to estimate abnormal returns around the date of option introduction.

Equally interesting are the results shown in the top half of Table 12: long-term post-listing performance is negative even during the pre-1980 period, when listing-window abnormal returns are significantly positive. This further strengthens the conclusion that the positive pre-1980 listing price effect of option introductions is only temporary.

Stock Price Manipulation Revisited

Since the upper half of Table 12 shows that the longer-term abnormal performance of optioned stocks is negative even during 1973-1980, it is interesting to assess the robustness of the market manipulation analysis presented in Chapter 5, using the abnormal returns estimated over the L-200/L-100 period. Table 13 repeats the analysis of Table 5, panel A, by analyzing the cross-sectional relation between listing abnormal returns and either market capitalization or stock volatility (computed during the L-200/L-100 estimation period). As in Table 5, I find significant positive correlation between the listing price effect and stock volatility (t=3.409), and significant negative correlation between listing price effect and firm size (t=-3.202). These results are once again consistent with the hypothesis that option dealers manipulate mostly small stocks with large volatilities. As in Table 5, repeating the analysis in Table 13 for the 1981-1992 period (not shown) reveals no statistical relation between price effects and either one of the two explanatory variables.

The market manipulation hypothesis is further supported by Table 14, which like Table 7, makes use of quartile analysis instead of cross-sectional regressions to detect any relation between price effect and explanatory variables. As shown in Table 14, using the L-200/L-100 estimation period does not substantially alter the conclusions already reached in Table 7: The positive price effect of option introductions occurs mostly for smaller stocks (4.71% for the lowest size quartile, t=2.52), and for stocks with high standard deviation (4.95% for the highest volatility quartile, t=3.45). The interactive analysis reveals that the positive price effect of option introduction is almost 6% for the smallest, most volatile stocks, which are more likely to be manipulated.

Using the L-200/L-100 estimation period does not therefore alter the conclusion of the market manipulation analysis presented in Chapter 5.

The Case Against the Selection Bias Hypotheses

Overall, the evidence presented in this chapter appears to refute the selection bias hypothesis: all of the results thus far presented in this dissertation are robust to a plausible change in the market model estimation period, from L-100/L-5 to L-200/L-100.

In addition, this evidence also suggests that the "true" price effect of option introduction is negative throughout the entire sample period, ranging from 1973 to 1992. During the 1973-1980 period this negative effect is however eclipsed by the short-term positive price run-up caused by manipulatory trading. However, when the longer-term stock performance is examined, the negative price effect becomes readily apparent, as indicated in the top half of Table 12. After market manipulation ceases at the end of 1980, the negative price effect becomes discernible starting with the very first day of the post-listing period, and appears to last for at least 200 trading days after listing.

In light of the findings presented in this chapter, it becomes important to understand the reason for which options negatively affect the performance of their underlying stocks. The following chapter presents one plausible explanation, based upon the effect of options on the stock market's informational structure.

Table 9: Descriptive Statistics for the Full and Target Samples

This table presents descriptive statistics about the size of the following two samples: the full sample, consisting of all stocks optioned between 1981 and 1992, and the target sample, consisting of stocks which were trading over $12 per share during the 120 days prior to the option listing event.

Period	Type of Listing	Overall Sample:	Target Sample:	Size of the Target Sample vs. the Overall Sample (%)
1973-1980	Calls only	240	235	97.9
1981-1992	Entire sample	893	815	91.3
1981-1992	Joint puts and calls	523	465	88.9
1981-1992	Calls only	370	350	94.6

Sample Definition:

- Overall Sample: Total number of call and put/calls listed during 1981-1992.
- Target Sample: Total number of call and put/calls listed during 1981-1992, for which the stock price was over $12 during the entire pre-listing period.

Table 10: The price effect of options introduction computed using a market model estimated during the L-200/L-100 period

This table repeats the analysis of Table 2, with a market model estimated during the L-200/L-100 period, where L represents the listing date. As with table 2, abnormal returns are calculated using the Brown and Warner (1985) methodology. When more than one stock became optioned on a given day, a portfolio of all such stocks is formed, and subsequently treated as a single security. The event window extends from L-5 to L+5.

Period	Sample	Number of Events	CAR(s) -- Market Model	T-stat. -- Market Model
1973-1980	All stocks (calls and put/call listings)	81	2.02 %	*3.037****
	Call listings only	80	1.94 %	*2.950****
	Put /Call listings only	---	--	--
	Put listings only	9	-0.02 %	*-0.011*
	Calls and put/calls, NYSE stocks only	81	2.02 %	*3.037****
	Calls and put/calls, NASDAQ stocks only	--	--	--
1981-1992	All stocks (calls and put/call listings)	377	-1.18 %	*-3.204****
	Call listings only	156	-0.52%	*-1.648**
	Put /Call listings only	226	-1.64 %	*-2.958****
	Put listings only	9	1.44 %	*0.700*
	Calls and put/calls, NYSE stocks only	244	-0.63%	*-1.469*
	Calls and put/calls, NASDAQ stocks only	179	-1.91 %	*-2.811****

Table 10. Continued

Significance Levels:

***	Significant at the 1% level
**	Significant at the 5% level
*	Significant at the 10% level
-	Insufficient data

Variable Definition:

- Number of Events: Number of days during which one or more option contracts get listed.

- CARs (Market Model): Cumulative abnormal returns, from day L-5 to L+5, calculated using the market model estimated from L-100 to L-6.

Table 11 The price effect of options introduction computed using a market model estimated during the L+100/L+200 period

This table repeats the analysis of Table 2, with a market model estimated during the L+100/L+200 period, where L represents the listing date. As with table 2, abnormal returns are calculated using the Brown and Warner (1985) methodology. When more than one stock became optioned on a given day, a portfolio of all such stocks is formed, and subsequently treated as a single security. The event window extends from L-5 to L+5.

Period	Sample	Number of Events	CAR(s) -- Market Model	T-stat. -- Market Model
1973-1980	All stocks (calls and put/call listings)	82	3.15 %	*4.624****
	Call listings only	81	3.11 %	*4.588****
	Put /Call listings only	--	--	--
	Put listings only	9	0.25 %	*0.192*
	Calls and put/calls, NYSE stocks only	82	3.15 %	*4.624****
	Calls and put/calls, NASDAQ stocks only	--	--	--
1981-1992	All stocks (calls and put/call listings)	377	0.07 %	*0.190*
	Call listings only	155	0.29 %	*0.526*
	Put /Call listings only	226	-0.06 %	*-0.115*
	Put listings only	9	0.96 %	*0.459*
	Calls and put/calls, NYSE stocks only	244	0.53 %	*1.188*
	Calls and put/calls, NASDAQ stocks only	179	-0.56 %	*-0.820*

Table 11. Continued

Significance Levels:

***	Significant at the 1% level
**	Significant at the 5% level
*	Significant at the 10% level
-	Insufficient data

Variable Definition:

- Number of Events: Number of days during which one or more option contracts get listed.

- CARs (Market Model): Cumulative abnormal returns, from day L-5 to L+5, calculated using the market model estimated from L-100 to L-6.

Table 12: Cumulative Abnormal Returns (CARs) of post-listing extended periods, estimated using pre-listing models

This table shows the cumulative abnormal returns of extended post-listing periods, calculated using market models estimated in two different pre-listing periods, using the Brown and Warner (1985) methodology. When more than one stock became optioned on a given day, a portfolio of all such stocks is formed, and subsequently treated as a single security. The event window extends from L-5 to L+5.

Listing Period	Estimation Period	Post-listing Period	Number of Events	CAR (Market)	T-statistic
1973-1980	L-194 / L-100	L+6 / L+100	82	- 10.46 %	*-5.58****
		L+100 / L+194	82	-11.17 %	*-5.79****
	L-100 / L-6	L+6 / L+100	83	- 2.24 %	*-1.20*
		L+100 / L+194	83	- 3.98 %	*-2.36***
1981-1992	L-194 / L-100	L+6 / L+100	377	-13.33 %	*-10.42****
		L+100 / L+194	377	-11.49 %	*-9.07****
	L-100 / L-6	L+6 / L+100	427	-10.48 %	*-8.03****
		L+100 / L+194	427	- 9.82 %	*-7.85****

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table 12. Continued

Variable Definition:

- Number of Events: Number of days during which one or more option contracts get listed.

- CAR (Market): Cumulative abnormal returns, from day L-5 to L+5, calculated using the market model estimated from L-100 to L-6.

- L: The listing date.

Table 13: Cross-sectional regressions between listing period returns and two proxies for stock price manipulation: firm size and stock volatility. Cumulative Abnormal Returns computed using the market model estimated in the L-200/L-100 period.

This table is a test of the following joint hypothesis: (1) the listing period price effect and abnormal turnover are due to stock price manipulation, and (2) option dealers manipulate mostly small stocks, with large standard deviation. Standard errors are computed using a White heteroskedasticity consistent variance-covariance matrix.

This table covers listing events occurring during 1973-1980.

Dep. Variable	Indep. Variable	Constant Coeff.	Constant T-statistic	Indep. Var. Coeff.	Indep. Var. T-statistic	N. Obs.	Adj. R^2
CAR	LOG(CAP)	0.229	*3.046******	-0.0210	*-2.963******	64	0.120
CAR	SDR	-0.078	*-3.202******	3.991	*3.409******	64	0.145

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Variable Definitions:

- CAR: Cumulative Abnormal Returns, computed for the period ranging from L-5 to L+5. Abnormal returns are calculated using the Brown and Warner (1985) market model, estimated from L-200 to L-100, where L represents the listing date.

- CAP: The inflation-adjusted market capitalization, equal to the number of outstanding shares times the average share price during the event window. Figures are converted in 1983 constant dollars.

- LOG(CAP): The natural logarithm of CAP.

- SDR: The standard deviation of raw returns, computed over the pre-listing period. The pre-listing period extends from L-100 to L-6.

Table 14: Quartile analysis of the relations between (1) listing period returns and (2) firm size and stock volatility. Cumulative Abnormal Returns computed using the market model estimated in the L-200/L-100 period.

Like Table 13, this is a test of the following joint hypothesis: (1) the listing period price effect and abnormal turnover are due to stock price manipulation, and (2) option dealers manipulate mostly small stocks, with large standard deviation.

		Listing Period: 1973-1980			Listing Period: 1981-1992		
Indep. Variable	Quartile	CAR (%)	T- Stat.	N. Obs.	CAR (%)	T-Stat.	N. Obs.
CAP	1 (lowest)	4.71	*2.52***	19	1.61	*0.62*	18
	2	4.15	*2.00**	16	1.75	*1.32*	23
	3	-1.63	*-1.37*	16	-4.05	*-2.33***	23
	4 (highest)	-1.37	*-1.19*	13	-0.82	*-1.09*	24
SDR	1 (lowest)	-2.05	*-2.98***	13	-0.51	*-0.05*	24
	2	-0.83	*0.05*	17	-2.49	*-1.90**	24
	3	2.89	*2.16***	15	-1.47	*-0.61*	20
	4 (highest)	4.95	*2.19**	15	2.03	*1.00*	21
High CAP and low SDR		-1.67	*-1.51*	20	-2.03	*-2.17***	34
Low CAP and high SDR		5.91	*3.45****	25	2.26	*1.19*	27

Table 14. Continued

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Variable Definitions:

- CAR (list window): Cumulative Abnormal Returns, computed for the L-5/L+5 period. Abnormal returns are calculated using the Brown and Warner (1985) market model, estimated from L-200 to L-100, where L represents the listing date.

- CAP: The inflation-adjusted market capitalization, equal to the number of outstanding shares times the average share price during the event window. Figures are converted in 1983 constant dollars.

- LOG(CAP): The natural logarithm of CAP.

- SDR: The standard deviation of raw returns, computed over the pre-listing period. The pre-listing period extends from L-100 to L-6.

CHAPTER 7
THE INFORMATIONAL EFFECT OF OPTION LISTINGS

Introduction

Recent theoretical literature related to stock/options interactions has focused on the informational effect of options upon the market for primary securities. Stein (1987) and Back (1993) show that when a new market for a derivative security opens, the informational structure in the primary security market is modified, as some investors will prefer to migrate from the primary to the derivative market. In this chapter I investigate whether this explanation may account for the post-1980 negative price effect of option introduction, and show that the data is generally inconsistent with this information hypothesis.

Theoretical Foundations

A mechanism through which option listings could reveal private information operates as follows[1]:

- At time $t-1$ the uninformed investor forms his expectation about the firm's future earnings, to be released at time $t+1$. At the same time ($t-1$), the informed investor observes a signal about the firm's future earnings. At time $t-1$ the price of the stock reflects only public information.

- At time t the options market opens, and the informed migrates to that market. Depending upon the type of signal he had observed at $t-1$, the informed will either buy calls (if he has favorable information) or buy puts

[1] This follows Back (1993).

(if his information is unfavorable).[2] The trades of the informed investor will thus change option prices accordingly, resulting in the revelation of his private information. For example, if uninformed traders observe "over-priced" calls, they may conclude that the next earnings will exceed expectations. At the same time, under-priced calls (or over-priced puts) unveil unfavorable information about future firm performance. Thus, when options trading opens at time t, stock prices will immediately adjust to reflect all information available, whether private or public.

- Actual earnings are released at time $t+1$. If the informed signal was accurate, we should observe no further price reaction at that time. In essence, the arrival of options at time t has caused an early resolution of uncertainty regarding future firm performance. This suggest that options cause stocks to move from a "semi-strong" form of efficiency, towards a "stronger" form of efficiency in which stock prices reflect both private and public information.

This revelation mechanism is therefore based on two fundamental premises. First, revelation only occurs when the informed traders migrate to options. Recent theoretical work suggests that this does not automatically happen with every new option contract. Rather, informed traders will only abandon stocks when the options market is sufficiently noisy (Koticha, 1993 and Easley et al., 1993). The main intuition behind this result is as follows: stock options are inherently more attractive to informed traders because their considerable higher leverage provides better return on private information. At the same time, the proportion of noise traders is likely to be lower in options compared to stocks. To the extent that there are not sufficient noise traders in the market for a given option, the informed trader will prefer to continue trading in the stock market where his trades will be "hidden" among those of the numerous noise traders. In that case, moving to a low-noise options market will cause the option dealer to adjust the bid-ask spread in order

[2] If puts are not available the informed will enter a long stock position in conjunction with a short call position.

to exact rents from the informed's private information set. If those rents are sufficiently high, they will offset any benefits derived from the higher leverage in that market.[3]

The second fundamental premise of the revelation mechanism is that, even in those cases where the informed do migrate to options, revelation only occurs if the price pressure in the options market is discernible for the uninformed investor. According to the discussion in the previous paragraph, when the informed moves to the option market, the option dealer will update his prior beliefs about the future stock performance. If the option market is sufficiently noisy, the option dealer will keep his priors unchanged and no information is likely to be revealed through the options market. In less noisy option markets however, the dealer may adjust the option bid-ask spread to exact part of the informational rents from the informed trader, depending upon the number of noise traders present in that market. If the leverage benefits for the informed traders are higher that the informational rents charged, the informed will move to the options market, and--in the

[3] To better illustrate this revelation mechanism, consider the following example: In an economy where only stock trading is available, the stock trades for \$100 at time t-1. This price reflects only the public information available at that time, which represents the market's rational expectations about the firm's future earnings. Suppose that at the same time, an informed trader observes a perfect signal about the value of the next earnings to be released at time t+1. Suppose further that the type of signal he observes is unfavorable, so that the stock would trade for \$95 if this information were public. In the stock-only economy, the stock will continue to trade for \$100 until time t+1, when it will drop by \$5 to reflect the information being released through the earning announcement.

Consider now a stock-option economy, similar to one above, except for the introduction of calls and puts at time t. In this economy, the informed will want to migrate to options at time t, to take advantage of the increased leverage in the options market. The uninformed will then be able to discern the resulting price pressure in put contracts, and infer that the next earnings will be below public expectations. This will cause stock prices to adjust immediately (at time t) to their "true" \$95 price level. (By contrast, in the stock-only economy this adjustment occurs at time t+1.) In short, in the stock-option economy prices are more efficient as they reflect both private and public information.

process--reveal his information set to the uninformed investor, which will then impound it into stock prices.

Consequently, price pressure in the options markets will only be discernible in those cases where options markets are sufficiently noisy to attract informed traders, but not too noisy as to prevent option dealers to adjust their prior information.

Consistent with the argument that informed traders operate in options markets and their trades influence prices, Anthony (1988) shows that stock prices lag option prices by about one day.

In a somewhat different context, Figlewski and Webb (1993) find direct empirical evidence of price pressure in option markets: they show that puts trade above their arbitrage-based values, when underlying stocks have a high level of short interest.

To conclude, recent empirical and theoretical work demonstrates that option prices may and do depart from their arbitrage-based level, despite options being "redundant" securities. It is therefore reasonable to assume that by observing the pressure in option prices, the uninformed investors may unveil the informed trader's informational structure, in those cases where the informed migrates to the options market.

Overall, the theoretical discussion of the information hypothesis can be summarized as follows: option listings are likely to reveal information only when the option market is (1) sufficiently noisy to keep informational rents low, and (2) at the same time sufficiently "thin" to reveal the informational set of the informed traders.

Methodology

Identifying the Appropriate Samples

Since the revelation mechanism only operates when informed traders abandon the stock market, tests of the information hypothesis are more powerful when analyzing a subset of stocks which experience this type of investor migration.

In a world with only one informed trader per underlying stock, detecting whether or not the informed has chosen to migrate to options may be accomplished by comparing each stock's bid/ask adverse-selection component before and after option listing. Since adverse selection is a standard proxy for the presence of an informed trader (Stoll (1989)), informed migration could be detected by selecting stocks with a decrease in their adverse selection after option listing.[4]

However, if the stock has a large number of informed traders, only some of which prefer to migrate to the options market, the adverse selection component may actually increase, even if there is a net outflow of investors from the primary to the derivative market, because of the reduced competition among the remaining informed traders in the primary market (Admatti and Pfleiderer, 1988).

It is therefore difficult to identify a target sample of stocks for which investors migrate to the options market, simply by examining changes in adverse selection components. For this reason, I will conduct my empirical tests using (alternatively) the

[4] This method is also valid in the case where all informed traders simultaneously abandon the stock market at the time of option introduction.

entire sample of option introductions, and the target sub-sample for which the adverse selection component decreases.

Consequently, all of this chapter's results in essence represent tests of joint hypotheses: First, results obtained using the full sample represent a test of the joint hypothesis that: (i) the information mechanism holds true, and (ii) the majority of stocks experience a net migration of investors into the derivative market.

Second, results obtained using the target sub-sample represent a test of the joint hypothesis that (i) the information mechanism holds true, and (ii) informed investors always migrate simultaneously from the primary to the derivative market.

In order to identify stocks which belong to the target sub-sample, I calculate the change in the adverse selection component for the bid-ask spread, using the following methodology developed by George, Kaul and Nimalendran (1991):

For each stock I first calculate $R_{B,t}$, the bid-to-bid return at time t. I then calculate $R_{D,t}$ by subtracting $R_{B,t}$ from $R_{T,t}$, the transaction-based return at time t (equation (9)):

$$R_{D,t} = R_{T,t} - R_{B,t} \qquad (9)$$

Using $R_{D,t}$, I calculate π, the proportion of spread which is not due to adverse selection:

$$\pi = [2 \cdot \sqrt{-\operatorname{cov}(R_{D,t}, R_{D,t-1})}] \cdot \left(1 \big/ quoted\ spread \right) \qquad (10)$$

I then use equation (10) to estimate the adverse selection component as:

$$adverse\ selection = quoted\ spread \cdot (1 - \pi) \qquad (11)$$

Since this procedure requires data on actual quoted spreads, I am only using the sub-sample of stocks listed on the NASDAQ-NMS database, for which quoted spreads are readily available. This selection process is discussed in the Descriptive Statistics section presented below.

A second type of target sub-sample is also of particular interest. According to the main result presented in the previous theoretical section, revelation is more likely to occur when the benefits derived from the leverage differential between stock and options outweigh the informational costs paid by the informed trader to the option dealer. To the extent that short selling is more costly than long positions, this leverage differential will be greater for investors holding unfavorable information. Accordingly, I conjecture that the revelation hypothesis is more likely to be supported in the sub-sample composed of stocks for which the informed carry "bad news," my second target sub-sample of interest.

Testing the information hypothesis

I test the information hypothesis using the alternatively the full sample, and each of the two target sub-samples described in the previous section. Since the conclusions are identical across the three samples, I only report the results for the full sample, and the sub-sample containing stocks with a decrease in the bid-ask adverse selection component.

The main tests consist of comparing the price effect of option listings with a measure of unexpected firm performance, constructed using expectations formed at time t-1:

$$\textit{unexpected firm performance} = \textit{firm performance}\,(t+1) - E_{t-1}\left[\textit{firm performance}\,(t+1)\right] \quad (12)$$

The general regression is of the following form:

$$CAR\ (list) \quad = \quad \alpha_0 + \alpha_1 \cdot (unexpected\ firm\ performance) \qquad (13)$$

where a significantly positive α_1 is consistent with the revelation hypothesis. In this chapter I use unexpected earnings as a proxy for the "unexpected firm performance" term of equation 13.

Unexpected earnings represent the difference between the actual earnings announced immediately following the option listing, and their corresponding forecast released immediately prior to listing, obtained from the I/B/E/S database.[5] Suppose for example that for a given firm, the I/B/E/S expected earnings released one week before option listing were $1 per share. The actual earnings released after the listing turned out to be $1.30 per share. The $0.30 difference is a good measure of the private informational content of the informed traders, the day before the option became available. If this information is fully revealed by the informed migration, the stock price should increase by a multiple of $0.30 during the first day of option trading.

Descriptive Statistics

Table 15 shows changes in the bid-ask spread and its adverse selection component, resulting from option listing. Since bid-ask data is only available for stocks listed on NASDAQ's National Market System (NMS), my sample is constrained to the 334 stocks

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[5] I gratefully acknowledge the contribution of I/B/E/S International Inc. for providing earnings per share forecast data, available through the Institutional Brokers Estimate System. This data has been provided as part of a broad academic program to encourage earnings expectations research.

for which NMS data is available on the NASDAQ tapes.[6] Using these 334 NMS stocks, I find that the mean (absolute) spread decreases by approximately 0.6 cents per share, which is not significantly different from zero (t=-1.378).[7] However, a more careful analysis reveals that a considerable number of these stocks had a pre-listing spread equal to 12.5 cents per share (or 1/8), which is the lowest spread value allowed by the exchange. In this case, the stock market maker <u>cannot</u> reduce the spread any further, even if the economics of the microstructure model dictate otherwise. <u>Spread discreteness</u> therefore poses an important problem for identifying changes in bid-ask spreads: in some cases stock market makers would want to reduce spreads (for example, to accommodate for the departure of informed traders), but are unable to do so for practical reasons.[8] One way to overcome this difficulty is to consider only stocks with sufficiently high pre-listing spreads, which are less likely to be constrained by the existence of the 1/8 "floor." I therefore propose to select the sub-sample of all stocks with pre-listing spreads in excess of (or equal to) 25 cents per share. Of the 344 stocks listed on the NASDAQ-NMS tape, only 179 meet this criterion. When only these stocks are considered, the mean spread change is approximately -2.2 cents per share, which is significant at better than the 1% level (t=-2.718).

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[6] In addition, NMS data is not available prior to 1985. In my sample, the first listing date with corresponding NMS data available is June 3, 1985. The NMS sample is therefore constrained to options listed during 1985-1992.

[7] The change in mean spreads is computed as the difference between the mean spread averaged over the 100 trading days following the listing, and the mean spread averaged over the 100 days preceding the listing.

[8] I thank M. Nimalendran for pointing out this potential problem.

The situation is highly similar when only the changes in the adverse selection component are analyzed: using all 334 NMS stocks, the adverse selection component drops by approximately 0.6 cents per share, which is not statistically significant (t=-1.439). However, using only the 179 stocks which are unconstrained by spread discreteness, the adverse selection component drops by more than 2 cents per share, which is significant at better than the 1% level (t=-2.752). The overall decrease in both the bid-ask spread and its adverse selection component is therefore consistent with the joint hypothesis that (i) there is a net migration of informed traders from the stock to the options market, and (ii) the decision to migrate to the options market is unanimous: for a given stock, either all or none of the informed decide to move.

Descriptive statistics for unexpected earning components are presented in Table 16, for two different types of earning data: quarter-end, and year-end. Clearly, the advantage of using quarter-end data is that there will always be an earning announcement within the three months following the option listing (as opposed to twelve months in the case of year-end data). The closer the earning announcement occurs to the listing event, the better can the informational effect be isolated. By contrast, year-end data is likely to be noisier on average, since other exogenous events can influence the actual earnings form the time the option becomes listed until the time earnings are actually released. Nevertheless, year-end data is available for 904 of my sample firms, compared to only 664 firms for the quarterly data. Consequently, in this chapter I use both year-end and quarter-end earnings in order to test the information hypothesis. For each type of earnings, I compute the surprise component as the difference between the actual released earnings, and their most recent pre-listing forecast.

The first line in Table 16 shows that the surprise component during 1973-1980 is not significantly different from 0. By contrast, surprise components after 1980 are primarily negative: whether computed with year-end or quarter-end data, surprise components are significantly negative for the universe of all stocks with options listed between 1981 and 1992. While this observation is somewhat surprising, it could be explained by a possible upwards bias in the I/B/E/S estimates, which Butler and Lang (1991) have documented for the period 1983-1986.

Results of the Information Hypothesis Tests

Table 17 presents the full-sample results of the cross-sectional relations between price effects and unexpected earnings. The full sample used in this table includes all Call and joint Put/Call listings occurring between 1981 and 1992. Data from the pre-1980 period is not considered, because of the noise introduced by market manipulation during that period. The general form of the model estimated in this table is the following:

$$CAR = f(UNEXP) \quad (14)$$

where:

- CAR are the cumulative abnormal returns of underlying stocks measured inside the listing window; and
- $UNEXP$ is a measure of unexpected earnings, calculated as the difference between the actual earnings announced immediately after the listing and the I/B/E/S forecast released immediately before the listing. Both year-end and quarter-end earnings are used in this computation.

Table 17 is then divided into two panels, according to the type of earning data being utilized: year-end (Panel A) or quarter-end (Panel B).

In estimating equation (14), I use individual listing data rather than data obtained from grouping the stocks into portfolios as in Chapter 3. This procedure enables the comparison of each individual stock's abnormal return with its own set of private information. The main drawback of this method is that standard errors could be biased due to possible cross-sectional correlation in excess returns. As a remedy, (and also since the functional form of equation (14) is not known), I explore the following eight plausible specifications for each of the two panels in Table 17:

The <u>first model</u> is the Ordinary Least Squares linear model, with standard errors computed using a White heteroskedasticity-consistent variance-covariance matrix:

$$CAR = \alpha_0 + \alpha_1 UNEXP \qquad (15)$$

The <u>second model</u> uses a normalized measure of unexpected earnings, which consists of dividing the raw *UNEXP* variable by the standard deviation of the earnings forecast, computed in cross-section, among the various analysts. This in essence produces a Z-score for each unexpected announcement, correcting for the fact that some stocks are consistently more difficult to forecast than others.[9] As in the first model, standard errors are computed using a White heteroskedasticity-consistent variance-covariance matrix:

$$CAR = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F} \qquad (16)$$

where σ_F is the standard deviation of earning forecasts, computed among the various analysts.[10]

[9] I thank M. Nimalendran for suggesting this approach.

[10] For the purposes of this model, observations with only one forecast ($\sigma_F = 0$) are not taken into account.

Since earnings are announced only once per statistical period (year or quarter), considerable time may elapse from the option listing date until the following earning announcement. In the case of year-end data, this time lag may be as long as 364 days. It is plausible to assume that unexpected earnings computed for observations with a longer announcement lag are likely to be noisier. By contrast, the shorter the lag between the earnings forecast and the earnings announcement, the better the informational effect is isolated, the less noisy the unexpected earnings. To adjust for this fact, the <u>third</u> and <u>fourth</u> models estimate the Weighted Least Square versions of equations (15) and (16), using the inverse of *LAG* as the weighting variable, where *LAG* is the number of days between the earnings forecast release and the actual earnings announcement.

The <u>fifth</u> and <u>sixth</u> models estimate Probit versions of equations (15) and (16), where the dependent variable has been re-defined as a binary version of *CAR*, which takes on a value of 0 whenever $CAR \leq 0$, and a value of 1 for $CAR>0$. In this case, Probit models are a plausible alternative to linear models to the extent that we are only interested in relating the <u>sign</u> of the abnormal returns with the explanatory variables.

Lastly, the <u>seventh</u> and <u>eight</u> models represent a particular type of heteroskedasticity-adjusted versions of equations (15) and (16), where all variables are divided by the standard deviation of abnormal returns in the pre-listing period, as indicated in the following two equations:

$$\frac{CAR}{\sigma_A} = \frac{\alpha_0}{\sigma_A} + \alpha_1 \frac{UNEXP}{\sigma_A} \qquad (17)$$

$$\frac{CAR}{\sigma_A} = \frac{\alpha_0}{\sigma_A} + \alpha_1 \frac{UNEXP/\sigma_F}{\sigma_A} \qquad (18)$$

If the information hypothesis holds true, I expect to find a significantly positive α_1 in at least one of the eight models described above.

Panel A of Table 17 presents the results when year-end data are used to calculate unexpected earnings. Surprisingly, none of the eight models find a significantly positive relation between price effects and unexpected earnings. Coefficients of the independent variable tend to be generally negative, and in the case of the simple OLS regression, significantly negative, in sharp contrast with the predictions of the information hypothesis. In addition, R^2 measures are extremely low, with the highest R^2 not exceeding 0.1%. Overall the evidence presented in Panel A is strongly inconsistent with the information hypothesis.

Panel B of Table 17 presents the results when quarter-end data are used to calculate unexpected earnings. As with Panel A, none of the coefficients of the explanatory variable are significantly positive, as predicted by the theory. In fact, most coefficients are negative, though none are significantly different from zero. Also, R^2 measures continue to remain extremely low. Like Panel A, the evidence presented in this panel is totally inconsistent with the information hypothesis.

Table 18 repeats the analysis in Table 17 for the target sub-sample which only contains stocks experiencing a decrease in the adverse selection component of the bid-ask spread. In light of the previous theoretical discussion, the results of Table 18 represent tests of the joint hypothesis that (i) the information mechanism operates as conjectured, and (ii) the drop in the bid-ask adverse selection component is a good proxy for investor migration.

Panel A of Table 18 presents the results using year-end earning data. None of the eight models estimated carries a significant coefficient on the independent variable. When quarter-end earnings are used instead of year-end in Panel B, some of these coefficients become negative, in sharp contrast with theoretical predictions. Overall, none of the 16 models estimated in Table 18 carry a significantly positive coefficient on the unexpected earnings variable. Consequently, the data from this target sub-sample is also strongly inconsistent with the information hypothesis.

I have also evaluated the information hypothesis for the second target sub-sample, which only contains stocks with negative values of the *UNEXP* variable. The results (not shown) continue to be inconsistent with the information hypothesis: none of the eight regressions of interest carry a significantly positive coefficient for the independent variable.

The Case Against the Information Hypothesis

The totality of the evidence presented in Tables 17 and 18 soundly rejects the information hypothesis: the price effect of option introductions is not positively related to the private information held by informed investors at the time of listings. This result therefore appears to be inconsistent with the implications of the theoretical model found in Back (1993), at least as it relates to the informational effect of option listings. A different empirical implication of Back worth pursuing is that if options improve efficiency in stock prices, earning announcements for optioned stocks should produce lesser surprises than earning announcements for non-optioned stocks. I am planning to continue this line of research in future studies.

Table 15: Descriptive statistics for changes in bid-ask spreads and adverse selection components

Parameter	Sample	Mean Change	T-statistic	N. Obs.
Change in adverse selection (cents per share)	All NMS stocks	-0.654	*-1.439*	334
	NMS stocks with bid/ask spread $\geq$ \$0.25	-2.190	*-2.752* ***	179
Change in bid-ask spread (cents per share)	All NMS stocks	-0.637	*-1.378*	334
	NMS stocks with bid/ask spread $\geq$ \$0.25	-2.191	*-2.718* ***	179

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table 16: Descriptive statistics for surprise earning components: 1973-1992

Listing Period	Sample	Surprise Component Using Quarter-End Earnings			Surprise Component Using Year-End Earnings		
		% Surprise	T-stat	N. Obs.	% Surprise	T-stat	N. Obs.
1973-1980	Call-listings only	--	--	--	-0.23	*-0.71*	87
1981-1992	All listings (calls & put/calls)	-0.22	*-2.48*****	664	-2.14	*-2.68******	817
	Call listings only	-0.23	*-1.02*	220	-3.50	*-1.86****	341
	Put/Call listings only	-0.21	*-3.22******	444	-1.12	*-4.79******	476

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level
- Insufficient data

Table 17: Cross-sectional relations between listing Cumulative Abnormal Returns and a proxy for private information content, various specifications, full sample of all options listed during 1981-1992

Panel A: Cross-sectional results using year-end earnings.

Type of Model	Model Specification	Constant Coeff. *[T-stat.]*	Indep. Variable *[T-stat.]*	N. Obs	Adj. R^2
OLS[a]	$CAR = \alpha_0 + \alpha_1 UNEXP$	-0.0083 *[-2.69]****	-0.0163 *[-2.03]***	817	0.0005
OLS[a]	$CAR = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F}$	-0.0084 *[-2.75]****	-0.0315 *[-0.07]*	767	-0.0013
WLS, using FYLAG	$CAR = \alpha_0 + \alpha_1 UNEXP$	-0.0050 *[-1.75]**	-0.0145 *[-0.67]*	816	0.0005
WLS, using FYLAG	$CAR = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F}$	-0.0048 *[-1.67]**	0.3262 *[0.47]*	766	-0.0014
PROBIT	$CARBIN = \alpha_0 + \alpha_1 UNEXP$	-0.09312 *[-2.07]***	-0.5117 *[-0.78]*	817	--
PROBIT	$CARBIN = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F}$	-0.11935 *[-2.59]***	-6.9613 *[-0.73]*	767	--
OLS	$\frac{CAR}{\sigma_A} = \frac{\alpha_0}{\sigma_A} + \alpha_1 \frac{UNEXP}{\sigma_A}$	-0.0032 *[-1.22]*	-0.0106 *[-1.20]*	817	-0.0010
OLS	$\frac{CAR}{\sigma_A} = \frac{\alpha_0}{\sigma_A} + \alpha_1 \frac{UNEXP/\sigma_F}{\sigma_A}$	-0.0033 *[1.25]*	0.1295 *[0.25]*	767	0.0021

Table 17. Continued

Panel B: Cross-sectional results using quarter-end earnings

Type of Model	Model Specification	Constant Coeff. *[T-stat.]*	Indep. Variable *[T-stat.]*	N. Obs	Adj. R^2
OLS[a]	$CAR = \alpha_0 + \alpha_1 UNEXP$	-0.0073 *[-2.07]***	-0.0779 *[-0.60]*	664	-0.0011
OLS[a]	$CAR = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F}$	-0.0054 *[-1.42]*	-0.2445 *[-0.10]*	514	-0.0019
WLS, using QTLAG	$CAR = \alpha_0 + \alpha_1 UNEXP$	-0.0073 *[-2.04]***	-0.0747 *[-0.55]*	664	-0.0012
WLS, using QTLAG	$CAR = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F}$	-0.0041 *[-1.05]*	-0.8413 *[-0.52]*	514	-0.0019
PROBIT	$CARBIN = \alpha_0 + \alpha_1 UNEXP$	-0.0877 *[-1.79]**	-0.3686 *[-0.17]*	664	--
PROBIT	$CARBIN = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F}$	-0.0830 *[-1.49]*	-0.0183 *[-0.01]*	514	--
OLS	$\frac{CAR}{\sigma_A} = \frac{\alpha_0}{\sigma_A} + \alpha_1 \frac{UNEXP}{\sigma_A}$	-0.0005 *[-0.19]*	-0.0066 *[0.06]*	664	0.0055
OLS	$\frac{CAR}{\sigma_A} = \frac{\alpha_0}{\sigma_A} + \alpha_1 \frac{UNEXP/\sigma_F}{\sigma_A}$	0.0011 *[0.34]*	1.6077 *[0.82]*	514	0.0007

Note:

a) Standard errors computed using a White heteroskedasticity-consistent variance-covariance matrix.

Table 17. Continued

Significance Levels:

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level
- Insufficient data

Variable Definitions:

- CAR: Cumulative Abnormal Returns, computed for the L-5/L+5 period. Abnormal returns are calculated using the Brown and Warner (1985) market model, estimated from L-100 to L-6, where L represents the listing date.

- CARBIN: A binary version of CAR, equal to 1 for CAR≥0, and equal to 0 for CAR<0.

- UNEXP: A measure of unexpected earnings, calculated as the difference between the actual earnings announced immediately after the listing and the I/B/E/S forecast released immediately before the listing. Both year-end and quarter-end earnings are used in this computation.

- FYLAG: The number of calendar days between the release date of the year-end earnings forecast immediately preceding the options listing, and the announcement date of the actual year-end earnings.

- QTLAG: The number of calendar days between the release date of the quarter-end earnings forecast immediately preceding the options listing, and the announcement date of the actual quarter-end earnings.

- σ_F: The cross-sectional standard deviation of analyst forecasts for a given stock. When only one analyst forecast is available, σ_F is set to a missing value.

- σ_A: The standard deviations of abnormal returns calculated during the L-100/L-6 period.

- OLS: The Ordinary Least Squares model.

- WLS: The Weighted Least Squares model.

Table 18: Cross-sectional relations between listing Cumulative Abnormal Returns and a proxy for private information content, various specifications. Options listed during 1981-1992, who experience a decrease in the adverse selection component of the bid-ask spread.

Panel A: Cross-sectional results using year-end earnings.

Type of Model	Model Specification	Constant Coeff. *[T-stat.]*	Indep. Variable *[T-stat.]*	N. Obs	Adj. R^2
OLS[a]	$CAR = \alpha_0 + \alpha_1 UNEXP$	-0.0234 *[-2.44]***	-0.2884 *[-1.25]*	148	0.0142
OLS[a]	$CAR = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F}$	-0.0209 *[-2.11]***	-0.2439 *[-0.72]*	140	-0.0067
WLS, using FYLAG	$CAR = \alpha_0 + \alpha_1 UNEXP$	-0.0167 *[-1.93]**	-0.2431 *[-1.20]*	148	0.0030
WLS, using FYLAG	$CAR = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F}$	-0.0136 *[-1.52]*	0.0599 *[0.06]*	140	-0.0067
PROBIT	$CARBIN = \alpha_0 + \alpha_1 UNEXP$	-0.2856 *[-2.63]****	-3.3451 *[-1.38]*	148	--
PROBIT	$CARBIN = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F}$	-0.2830 *[-2.56]***	-14.042 *[-1.01]*	140	--
OLS[a]	$\frac{CAR}{\sigma_A} = \frac{\alpha_0}{\sigma_A} + \alpha_1 \frac{UNEXP}{\sigma_A}$	-0.0107 *[-1.37]*	-0.1732 *[-1.10]*	148	-0.0012
OLS[a]	$\frac{CAR}{\sigma_A} = \frac{\alpha_0}{\sigma_A} + \alpha_1 \frac{UNEXP/\sigma_F}{\sigma_A}$	-0.0097 *[-1.22]*	-0.2982 *[-1.13]*	140	-0.0023

Table 18. Continued

Panel B: Cross-sectional results using quarter-end earnings

Type of Model	Model Specification	Constant Coeff. *[T-stat.]*	Indep. Variable *[T-stat.]*	N. Obs	Adj. R^2
OLS[a]	$CAR = \alpha_0 + \alpha_1 UNEXP$	-0.0229 *[-2.50]***	-1.9555 *[-2.02]***	142	0.0294
OLS[a]	$CAR = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F}$	-0.0165 *[-1.61]*	-2.6197 *[-0.20]*	108	-0.0069
WLS, using QTLAG	$CAR = \alpha_0 + \alpha_1 UNEXP$	-0.0153 *[-1.67]**	-2.2444 *[-2.94]****	142	0.0294
WLS, using QTLAG	$CAR = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F}$	-0.0134 *[-1.19]*	-7.4580 *[-1.62]*	108	-0.0069
PROBIT	$CARBIN = \alpha_0 + \alpha_1 UNEXP$	-0.2800 *[-2.58]***	-17.482 *[-1.26]*	142	--
PROBIT	$CARBIN = \alpha_0 + \alpha_1 \frac{UNEXP}{\sigma_F}$	-0.2425 *[-2.00]***	-33.169 *[-0.62]*	108	--
OLS[a]	$\frac{CAR}{\sigma_A} = \frac{\alpha_0}{\sigma_A} + \alpha_1 \frac{UNEXP}{\sigma_A}$	-0.0110 *[-1.43]*	-1.5950 *[-1.72]**	142	0.0185
OLS[a]	$\frac{CAR}{\sigma_A} = \frac{\alpha_0}{\sigma_A} + \alpha_1 \frac{UNEXP/\sigma_F}{\sigma_A}$	-0.0041 *[-0.48]*	-2.9334 *[-0.28]*	108	-0.0090

Note:

a) Standard errors computed using a White heteroskedasticity-consistent variance-covariance matrix.

Table 18. Continued

Significance Levels:

***	Significant at the 1% level
**	Significant at the 5% level
*	Significant at the 10% level
-	Insufficient data

Variable Definitions:

- CAR: Cumulative Abnormal Returns, computed for the L-5/L+5 period. Abnormal returns are calculated using the Brown and Warner (1985) market model, estimated from L-100 to L-6, where L represents the listing date.

- CARBIN: A binary version of CAR, equal to 1 for $CAR \geq 0$, and equal to 0 for $CAR < 0$.

- UNEXP: A measure of unexpected earnings, calculated as the difference between the actual earnings announced immediately after the listing and the I/B/E/S forecast released immediately before the listing. Both year-end and quarter-end earnings are used in this computation.

- FYLAG: The number of calendar days between the release date of the year-end earnings forecast immediately preceding the options listing, and the announcement date of the actual year-end earnings.

- QTLAG: The number of calendar days between the release date of the quarter-end earnings forecast immediately preceding the options listing, and the announcement date of the actual quarter-end earnings.

- σ_F: The cross-sectional standard deviation of analyst forecasts for a given stock. When only one analyst forecast is available, σ_F is set to a missing value.

- σ_A: The standard deviations of abnormal returns calculated during the L-100/L-6 period.

- OLS: The Ordinary Least Squares model.

- WLS: The Weighted Least Squares model.

CHAPTER 8
SUMMARY AND CONCLUSIONS

Previous studies of stock-options interactions document a positive price effect of option introductions for the period 1973-1980. In recent years however, casual evidence suggests that many stock prices have been adversely affected by option listings. Accordingly, in this dissertation I examine the price effect of options introductions by extending the earlier studies' period to 1973-1992. While the positive, pre-1980 price effect is readily validated, the data presented in Chapter 3 show that the price effect of option introductions becomes negative starting in 1981.

Many authors have sought to rationalize the puzzling positive price effect of option introductions between 1973 and 1980. The most common explanation is that options complete the markets, which causes a change in equilibrium allocations and prices. There are, however, two problems with this explanation. The first is that theoretical models based on market completion do not provide inferences about the magnitude or direction of equilibrium changes resulting from the introduction of a new asset. Different utility functions, information structures, and initial endowments lead to different price reactions: some negative, some positive. There is therefore no reason to believe that market completion necessarily raises the price of the underlying asset, on average. The second difficulty with the market completion theory is that it cannot explain the reason why the positive price effect becomes negative precisely at the end of 1980, as documented in this dissertation.

In Chapters 4 and 5 of this dissertation I propose an explanation for the positive, pre-1980 price effects of option introduction. Far from the market completion hypothesis conjectured by Detemple and Jorion (1990), this explanation's origins lie at the opposite end of the economic paradigm: the pre-moratorium price run-ups do not reflect welfare-improving changes in macro-economic allocations, but rather disingenuous maneuvers by option dealers to exact rents from inexperienced investors. Starting in 1981, as the opportunities to manipulate stock prices substantially diminish, manipulative activities apparently cease. Surprisingly however, the price effect of option introductions becomes negative in 1981, instead of merely vanishing as it should. The presence of a negative price effect in the 1981-1992 period is a puzzling phenomenon which is carefully investigated in the next two chapters of this dissertation.

Chapter 6 examines whether the observed negative price effect of the post-1980 period is not in fact a mere result of a bias in the exchange selection mechanism. The chapter refutes this assertion by showing that the negative price effect is robust to a plausible change in the estimation period of the market model used in computing abnormal returns. More convincing evidence against the selection bias hypothesis could however be obtained by comparing the returns of the optioned stocks with those of a control sample of non-optioned stocks, having similar return characteristics in the pre-listing economy. I am planning to pursue this line of research in future studies.

Since the negative price effect does not appear to reflect a selection bias, alternative explanations must be explored. Chapter 7 presents a theoretical framework which links the price effect of option introduction with a measure of the private information held by informed traders at the time of listing. The empirical results presented in this chapter, however, strongly refute the information hypothesis: the price effect of option introductions is unrelated to informational content, as least as measured by my proxy.

Because the negative price effect of option introductions is not apparently related to either the selection bias or the information hypothesis, one other plausible explanatory hypothesis deserves serious consideration: the change in demand. Though there exist many reasons for which options may affect the demand for their underlying stocks, the most promising line of research consists of testing a general-equilibrium-based model by Jarrow (1980) related to the effect of short selling constraints on asset prices. One implication from Jarrow's model is that the price of an asset is always higher when short-selling is totally restricted, provided that it is possible to short-sell the market index. To the extent that the introduction of options in essence removes the short-selling constraint on the underlying stock, it follows that the stock price is always lower in the post-option economy, which is a priori consistent with the general results presented in Chapter 3. I consider this line of research to be promising, and am planning on pursuing it in future studies.

This dissertation has important implications for both academic scholars and government regulators. First, it shows that our abilities to analyze stock/option interactions are considerably affected by the regulatory environment of standardized option trading. Since the pre-1980 period is marked by instances of stock price manipulation, other economic effects may not be discernible during that period, even if they are actually present. By contrast, the post-1980 period provides a "cleaner" set of option introductions, which are more suitable for empirical studies about the economic effects of exchange-traded stock options.

Second, the research highlights the importance of having adequate government supervision in financial markets. In a totally unregulated environment, market "insiders" are likely to devise disingenuous schemes to take advantage of their privileged position, at the expense of the "ordinary" investor. This dissertation documents one possible consequence of inadequate regulation and lenient enforcement: option dealers taking advantage of "good faith credit" and "free riding" to increase their personal gains by selling substantially over-priced call options. Since federal regulators have a mandate to promote "fair and orderly markets," a close monitoring of market maker activities is essential to ensure that financial markets represent a "fair game" for all market participants.

Third, unlike much of the recent theoretical results, no evidence is found in this dissertation that options improve efficiency in stock prices, at least around the time of option introductions. This results should be of particular interest to regulators, as it provides additional useful information to assess the economic effect of options trading.

Lastly, the overall results discussed in this dissertation support the hypothesis that the negative price effect of option introduction represents a true change in the equilibrium price of underlying stocks. Otherwise stated, <u>options decrease stock prices</u>. A possible reason for this effect is the removal of short sale constraints associated with option listings. Understanding this new aspect of the interactions between stocks and options remains an interesting issue for further research.

APPENDIX
MATHEMATICAL RELATION BETWEEN RETURNS STANDARD DEVIATION AND INCENTIVES TO MANIPULATE STOCK PRICES

This appendix proves that for a 2-state, 2-period economy, the profit derived from manipulating stock prices is greater for stocks with higher pre-listing volatilities.

Consider an economy with the following assumptions:

- The risk-free rate equals zero.
- There are only two time periods, $t=0$ and $t=1$.
- At time $t=1$ there are only two states of nature: $\omega=1$ and $\omega=2$.
- The following two primary assets trade in this economy at $t=0$: a risky stock and a risk-free bond.
- At $t=0$ the stock price equals P.
- The stock's payoffs at $t=1$ vary as a function of the state of nature as follows:
    - For $\omega=0$, the payoff is $P+R-\sigma$, and
    - For $\omega=1$, the payoff is $P+R+\sigma$.

  where R represents the stock's expected return, and σ is proportional to its return volatility. (It is assumed that $R \geq 0$.)
- The price of the risk-free bond at $t=0$ is normalized to 1.
- Since the risk-free rate is zero, the bond's payoffs at $t=1$ are also equal to 1 in both states of nature.
- At $t=0^-$ a call option is announced to commence trading at $t=0^+$.
- At $t=0$ the call writer has the opportunity to manipulate the price of the underlying stock, by artificially inflating its price from P to P^*, where $P^* = P+\Delta P$.

- At that time the future stock payoffs at $t=1$ are perceived by the market to be as follows:
  - For $\omega = 0$, the payoff is believed to be P*+R-σ; and
  - For $\omega = 1$, the payoff is believed to be P*+R+σ.
- At $t=0^+$, the call writer issues the first call contract, with a strike price (K) equal to the underlying stock price observed in the market at that time. Thus $K=P^*$.

Proposition 1: The standard deviation of the stock's rate of return is given by σ/P.

Proof: Let s be the standard deviation of stock returns. Then, by definition of the variance, we have:

$$s^2 = \frac{1}{2}\left[\frac{R+\sigma}{P} - \frac{R}{P}\right]^2 + \frac{1}{2}\left[\frac{R-\sigma}{P} - \frac{R}{P}\right]^2 \qquad \text{(A-1)}$$

Simplifying (A-1) it follows that:

$$s = \frac{\sigma}{P} \qquad \text{(A-2)}$$

Suppose that at $t=0$ the stock price is artificially inflated to P^*. Then, at time $t=0^+$, the option dealer issues one call contract, with a strike price $K=P^*$. At that time, the market believes that P^* is the "true" stock price. Accordingly, the market value of the call contract is determined as a function of P^* and the perceived stock return process in the artificially-inflated economy. Throughout the rest of this appendix, the star (*) symbol will be used to denote variables defined with respect to the inflated economy, where the stock price has been artificially increased from P to P^*.

Proposition 2: The price of the Call option in the artificially-inflated economy is given by:

$$C^* = \frac{R+\sigma}{2\sigma}(\sigma - R) \tag{A-3}$$

Proof: At time $t=1$, the payoffs of the Call contract are as follows:

- $R+\sigma$ if $\omega=1$
- 0 if $\omega=0$. (A-4)

The $t=1$ payoffs of the call contract can be replicated by building a portfolio composed of S^* shares of stocks, and B^* units of risk-free bonds. Using the arbitrage principle, the following quantities of stocks and bonds are required for a complete replication of the Call payoffs at $t=1$:

$$S^* = \frac{R+\sigma}{2\sigma} \tag{A-5}$$

and

$$B^* = -\left(\frac{R+\sigma}{2\sigma}\right)(P^* + R - \sigma) \tag{A-6}$$

The price of the Call at $t=0$ can then be determined by calculating the price of the replicating portfolio at $t=0$:

$$C^* = S^* P^* + B^* = \left(\frac{R+\sigma}{2\sigma}\right)(\sigma - R) \tag{A-7}$$

which completes the proof of Proposition 2.

Proposition 3: The true price of the call contract in the "true" (non-inflated) economy would have been:

$$C = \frac{R+\sigma - \Delta P}{2\sigma}(\sigma - R) \tag{A-8}$$

Proof: At time $t=1$, the true payoffs of the Call contract are as follows:

- $R+\sigma-\Delta P$ if $\omega=1$
- 0 if $\omega=0$. (A-9)

The $t=1$ payoffs of the Call contract can be replicated by building a portfolio composed of S shares of stocks, and B units of risk-free bonds. Using the arbitrage principle, the following quantities of stocks and bonds are required for a complete replication of the Call payoffs at $t=1$:

$$S = \frac{R+\sigma-\Delta P}{2\sigma} \tag{A-10}$$

and

$$B = -\left(\frac{R+\sigma-\Delta P}{2\sigma}\right)(P+R-\sigma) \tag{A-11}$$

Once again, the price of the Call at $t=0$ can then be determined by calculating the price of the replicating portfolio at $t=0$:

$$C = SP + B = \left(\frac{R+\sigma-\Delta P}{2\sigma}\right)(\sigma - R) \tag{A-12}$$

which completes the proof of Proposition 3.

<u>Proposition 4:</u> <u>Ceteris paribus</u>, the benefits from manipulating stock prices are greater for stocks with higher σ-values.

<u>Proof:</u> Let π denote the benefits derived by the option dealer from the stock price manipulation. Then:

$$\pi = C^* - C \tag{A-13}$$

substituting (A-8) and (A-12) in (A-13), it follows that:

$$\pi = \left(\frac{\sigma - R}{2\sigma}\right) \Delta P \tag{A-14}$$

taking the first derivative of π with respect to σ in equation (A-14) we obtain the proof of the proposition:

$$\partial\pi / \partial\sigma = \frac{R\,\Delta P}{2\sigma^2} > 0 \qquad \text{(A-15)}$$

The main result of this Appendix can now be stated as follows:

Proposition 5: The benefits from manipulating stock prices are higher for stocks with high return standard deviation in the pre-listing economy.

Proof: The proof follows from propositions 1 and 4.

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BIOGRAPHICAL SKETCH

Sorin Sorescu received a bachelor's degree in electrical engineering in 1989, and a Master of Business Administration degree in 1991, both from McGill University. During his Ph.D. studies at University of Florida he published in the Journal of Finance, and was the recipient of the 1995 Financial Management Award for the Best Paper in Financial Institutions. His research focuses on financial markets regulation, financial innovations and the economic effects of derivative securities.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

M J Flannery

Mark J. Flannery, Chair
Barnett Bank Eminent Scholar of Finance

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

David T. Brown

David T. Brown
Associate Professor of Finance, Insurance, and Real Estate

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

M Nimalendran

Mahendrarajah Nimalendran
Associate Professor of Finance, Insurance, and Real Estate

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Jonathan Hamilton

Jonathan Hamilton
Professor of Economics

This dissertation was submitted to the Graduate Faculty of the Department of Finance, Insurance and Real Estate in the College of Business Administration and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August 1996

Dean, Graduate School