Buyback Trading of Open Market Share Repurchase Firms and the Return Volatility Decline*

Jaemin Kim**

College of Business Administration, San Diego State University, San Diego, CA 92182

Abstract

I find evidence that an open market share repurchase firm, by actively buying back its shares when the share price falls, supports the price and reduces return volatility. Results suggest that it is the actual buyback trading activity, not the announcement itself, that is significantly negatively associated with changes in return volatility. I also show that CAPM beta decreases only when the firm buys back shares actively. The evidence presented in this paper is consistent with the price support motive explanation of open market share repurchases.

JEL Classification: G30, G35

Key words: share repurchase, return volatility, actual buyback trading

---

*This paper is from a chapter of my Ph.D. dissertation at the University of Washington. I thank members of my dissertation committee, David Ikenberry, Jennifer Koski, Jeffrey Pontiff, Thomas Richardson, and particularly Edward Rice (chair). I also thank Larry Dann, Diance Del Guercio, Kathryn Dewenter, Alan Hess, Nobuyuki Isagawa, Jayant Kale, Avraham Kamara, Sandy Klasa, Paul Malatesta, Wayne Mikkelson, Walter Novaes, Joel Sneed, and the seminar participants at the University of Washington, Seattle University, and the University of Oregon. Special thanks go to Kim Woo Choong, former Chairman of Daewoo Group, and Park Chung Kil for their support of my Ph.D. work at the University of Washington.

**Jaemin Kim: College of Business Administration, San Diego State University, 5500 Campanile Drive, San Diego, CA 92182-8236. Voice/Fax: 619-594-2721/3272. E-mail: jkim@mail.sdsu.edu.

1. Introduction

Open market share repurchases by publicly traded corporations in the United States have been increasing substantially through the 1990s. According to Grullon and Ikenberry (2000), in 1998, for the first time in history, the estimated dollar amount distributed through share repurchases exceeded the dollar amount distributed through cash dividends. In 1998 and in 1999, open market share repurchases accounted for more than 95 % of the total dollar value of share repurchases. Fama and French (2001) document that in 1998, only 20.7 % of all publicly traded corporations paid dividends in the United States, whereas in 1978, 66.5 % of all U.S. public corporations paid dividends.

A question that has not been explored in the literature on increasingly important share repurchases is whether and how open market share repurchase affects total risk or return volatility of a firm's stock. Previous studies that investigate risk changes related to share repurchases are focused on tender offer share repurchases. Dann, Masulis, and Mayers (1991) find reduction of equity systematic risk following tender offer repurchase announcements. Hertzel and Jain (1991) provide evidence of the equity beta decline after tender offer repurchases. Denis and Kadlec (1994) argue that systematic risk changes following equity offerings and tender offer share repurchases are insignificant after correcting for biases caused by infrequent trading and price adjustment delays. As for open market share repurchases, the dominant form of share repurchases, there is one study by Bartov (1991). Bartov (1991) examines changes in CAPM beta associated with open market share repurchases and finds a beta decline.

All those studies examine changes in systematic risk (CAPM beta) as opposed to total risk. To this author's knowledge, there is no study that directly investigates changes in total risk or return volatility for open market share repurchases. In this paper, I examine this unexplored, yet important question of return volatility associated with open market share repurchases.

Campbell, Lettau, Malkiel, and Xu (2001) find that individual stock return volatility has more than doubled between 1962 and 1997, and they summarize five reasons for the importance of studying individual

stock return volatility (and also industry-level volatility) in addition to market volatility. Based on Campbell et al, here I list four reasons why individual stock return volatility is an important subject.

First, there are many investors who hold undiversified portfolios, and to these investors, individual stock return volatility is important. Second, to the extent that changes in individual return volatility affect risk that is priced (systematic risk), examination of changes in individual stock return volatility is of substantial significance. Third, individual stock return volatility as well as market volatility is an important factor to arbitrageurs as they attempt to capture gains from mispricing of an individual stock. And fourth, the value of an option on a stock is directly affected by a change in individual stock volatility.

In my study, I measure individual stock return volatility by daily return standard deviation, and first, I examine pre-announcement 60 trading days and post-announcement 60 trading days.[1]

Return volatility, as measured by daily return standard deviations, decreases significantly for the firms that actively buy back shares, whereas for the firms that do not buy back shares actively, return volatility does not decrease. Both univariate and multiple regression analyses show that it is the actual buyback trading activity of a repurchase firm, not the announcement itself, that is significantly related to the decrease in daily return standard deviation. I present evidence that repurchase managers have a tendency to engage in buyback trading more actively when the share price falls low in the price distribution that the managers have in mind, and that this pattern of buyback trading activity reduces price volatility and therefore return volatility (the *Buyback Trading Hypothesis*). The volatility-matched control sample analysis shows that this volatility decline is not a result of either a market wide volatility decline or volatility mean reversion.

Next, I perform longer term analyses that examine four fiscal quarters following the announcement quarter. The results show that if firms reduce buyback trading intensity, then return volatility goes back up,

[1] As will be explained in a following section, as a robustness check, I also examine the pre-announcement period of day –65 through day –6 and the post-announcement period of day +6 through day +65 (day 0 = announcement day). The results remain unchanged with this different time frame.

and that if firms increase buyback trading intensity, then return volatility decreases further. Again, I document a significant negative relation between buyback trading intensity and volatility changes.

Volatility can decline as a firm moves from a growth phase to a more mature phase, experiencing reduced growth options (the *Reduced Growth Option Hypothesis*). This explanation offers a reason for a volatility decline that is different from buyback trading. However, I find no convincing evidence that the share repurchase signals a firm moving into a more mature phase. That is, I find no evidence that repurchase firms face reduced investment opportunity sets or growth options after repurchase announcements.

Finally, to see the economic significance of the statistically significant return volatility decline, I examine changes in systematic risk as measured by CAPM beta. Just like the results for return volatility changes, CAPM beta goes down significantly only when firms buy back shares actively, and CAPM beta does not go down when the firms do not buy back shares. This again renders further support for the relation between actual buyback trading and the return volatility decline, which eventually leads to the systematic risk decline. Using the Black-Scholes option formula, I also present simple numerical examples that illustrate economically significant changes in option prices resulting from the return volatility decline documented in this paper.

This paper is the first study to document a significant decline in total risk or return volatility (daily return standard deviation) with respect to open market share repurchases. Most importantly, this study connects return volatility changes, as well as CAPM beta changes, to actual buyback trading activity. Throughout this paper, evidence consistently indicates that it is the actual buyback trading activity of a repurchase firm that is significantly negatively associated with the volatility change and the CAPM beta change.

There are several explanations as to why firms implement open market share repurchase programs.[2] The share repurchase can be used to signal share undervaluation (Vermaelen (1981) and Ikenberry, Lakonishok, and Vermaelen (2000)). The share repurchase can be used to distribute excess cash flow and

[2] Grullon and Ikenberry (2000) provide a comprehensive survey on why companies buy back their own shares.

thereby reduce agency cost (Jensen (1986) and Lie (2000)). Also, Cook, Krigman, and Leach (2000) present evidence for price support motives of open market share repurchases. As suggested by Dittmar (2000), it is likely that these different motives co-exist to a differing degree depending upon firm specific situations.[3]

The results of this paper are consistent with the price support motive explanation in the sense that an open market share repurchase firm supports its price and reduces its return volatility by actively buying back its own shares when the share price falls in the lower tail of the price distribution that the managers have in mind.

The remainder of the paper is organized as follows. Section 2 contains hypothesis development. Section 3 describes the sample and the data. In section 4, I present the results of empirical analyses, and in section 5, I perform longer term analyses. In section 6, I examine the economic significance of the return volatility decline, and lastly, I discuss future research and conclude in section 7.

2. Hypothesis development

In this section, I present the *Volatility Increase Hypothesis* and two versions of the *Volatility Decrease Hypotheses*. The two versions of the *Volatility Decrease Hypotheses* are the *Buyback Trading Hypothesis* and the *Reduced Growth Option Hypothesis*.

2.1. Volatility Increase Hypothesis

[3] There are also explanations that relate employee/executive stock-options to open market share repurchases. See Weisbenner (2000), Fenn and Liang (2001) and Kahle (2002).

Return volatility can increase with share repurchases. As a firm repurchases its own shares, a debt-to-equity ratio rises as the equity base shrinks, while the amount of debt remains unchanged. Increased leverage makes equity riskier, resulting in an increase in volatility.

In addition to a leverage change, the nature of the assets of a repurchase firm changes as cash is used to buy back its shares. Reduced cash means that a larger proportion of assets consists of non-cash assets or riskier assets. Increased risk of assets tends to increase return volatility.

The *Volatility Increase Hypothesis* is based on these changes in leverage and asset composition: The cash outlay and higher leverage following a share repurchase increase equity risk and asset risk of a repurchase firm, leading to an increase in daily return standard deviation.

2.2. Volatility Decrease Hypotheses

2.2.1. Buyback Trading Hypothesis

The first of the two *Volatility Decrease Hypotheses* is what I call the *Buyback Trading Hypothesis*. The *Buyback Trading Hypothesis* is based on repurchase managers' tendency to engage in buyback trading more actively when the managers believe the share price is 'too low'.

Assume a hypothetical price distribution, like the one in Figure 1, that the managers have in mind. Then, one can think of 'price being low' as the share price falling in the lower tail of this price distribution, or in the left side of the vertical line that stands for the mean value. The first graph in Figure 1 represents a price distribution that will be realized if the firm does not buy back. The second graph is a price distribution that will be realized if the firm buys back shares when the share price falls in the lower tail of the distribution. The second graph is a sort of truncated price distribution that is 'leaner' than the first one. Here I assume a locally downward sloping demand curve for a share, so that the firm's repurchases can increase

price or prevent a price fall.[4] As the price falls in the lower tail of the distribution, the firm repurchases its shares. As illustrated by the arrows on the second graph, added buying demand resulting from this repurchase activity increases its price, thus shrinking price dispersion. In other words, price dispersion or price volatility diminishes when the managers engage in buyback trading as the share price falls low in the distribution that the managers have in mind.

If the mean value in the graph is assumed to be the true, intrinsic value of the share, then the price falling in the lower tail means the share being undervalued. However, in this paper, I do not make the potentially restrictive assumption that the mean value is the true value of the share. Managers have a sort of target distribution in mind like the ones in Figure 1. And these managers tend to engage in buyback trading more actively when the price falls in the lower tail of the distribution, not necessarily when the share gets undervalued. That is, managers have a tendency to buy back more aggressively when the price is lower than the price they would have liked, not necessarily when the price is lower than its true value.

The findings of previous studies are consistent with the managers' tendency to engage in buyback trading when the share price falls. Brockman and Chung (2001) find strong evidence of managers' repurchase cost minimization ability that beats naïve trading strategies. Ikenberry, Lakonishok, and Vermaelen (2000) study share repurchases of Toronto Stock Exchange listed firms and show evidence of more aggressive repurchase activity following price drops. Cook, Krigman, and Leach (2000) also show similar results for NYSE firms.

The *Buyback Trading Hypothesis* is stated as follows: A repurchase firm has a tendency to engage in buyback trading more actively when the price falls in the lower tail of the price distribution that the managers have in mind. This tendency will result in reduced price volatility and therefore reduced return volatility as measured by daily return standard deviation.

[4] Among others, Rice (1999) argues that stock price changes have different welfare consequences for shareholders with heterogeneous demand elasticities for a share. His argument is based on a downward sloping demand curve for a share.

2.2.2. *Reduced Growth Option Hypothesis*

The second version of the *Volatility Decrease Hypotheses* is what I refer to as the *Reduced Growth Option Hypothesis*. This hypothesis offers an explanation alternative to the *Buyback Trading Hypothesis* as to why return volatility might go down with share repurchases.

Volatility can decline as growth options of a firm decrease, or as the investment opportunity set of a firm diminishes. Reduced growth options or diminishing investment opportunities are the characteristics of a firm in transition from a growth phase to a more mature phase. As a firm gets more mature, the amount of growth options will decrease, cash flows will tend to become less volatile, and therefore, equity risk will go down. Grullon, Michaely, and Swaminathan (2001) document a significant decline in systematic risk for dividend increasing firms, and suggest that dividend changes can be signs of a firm getting more mature. Open market share repurchases, a corporate payout method alternative to dividends, can be another firm maturity signal of reduced growth opportunities and reduced risk. Thus, in the *Reduced Growth Option Hypothesis*, return volatility decreases because a firm moves to a more mature phase, a reason that is different from that of the *Buyback Trading Hypothesis*.

The *Reduced Growth Option Hypothesis* is stated as follows: Return volatility, as measured by daily return standard deviation, decreases as a result of reduced growth options of a firm (or a firm getting more mature), not the buyback trading activity of a firm.

3. Sample and data

I acquire open market share repurchase announcement data from the Thomson Financial SDC Platinum Mergers and Acquisition database for the period from January 1990 to December 1992. From 1990 to 1992, there are 1,463 open market share repurchase announcements. This study uses mostly + 60 and - 60 trading day window relative to day 0, or the announcement day. That is, 60 trading days prior to each

announcement and 60 trading days after each announcement are examined. Among the 1,463 announcements, 52 stock splits and 12 stock dividends fall in this 121 trading day window. Among many studies on stock splits and their market microstructure effects, Koski (1998) documents an increase in variance of daily returns following ex-dates of stock splits and stock dividends. To avoid potentially confounding effects of stock splits, I exclude those 64 announcements from my original sample, and this results in the sample size of 1,399.

To measure daily return standard deviations, I use midpoints of daily closing bid-ask spreads from the tapes of the Institute for the Study of Security Markets (ISSM). The reason I use intraday data is to measure return volatility more accurately by avoiding artificial volatility created by bid-ask bounce. This process, however, results in a significant reduction in my sample size. The sample size is reduced to 978 from the 1,399 that I started with, because the ISSM data suffer from a missing observation problem. Reading the ISSM tapes requires ticker symbols and CRSP trading day indices. 739 out of the 1,399 in the original sample are announcements made by NASDAQ firms, and out of those 739 announcements, ticker symbols that correspond to 396 announcements are not in the ISSM tapes. That is, for more than 50 % of the NASDAQ announcement sample, the corresponding data are not available in the ISSM NASDAQ tapes. For the NASDAQ announcements made in 1992, in particular, I lose all the observations, which are 236 announcements in my initial sample. On the other hand, in the ISSM NYSE/AMEX tapes, data are available for more than 95 % of the NYSE/AMEX repurchase announcements.[5]

Two data issues deserve elaboration. The first issue is the sample period of 1990-1992. This period is chosen because the ISSM tapes are no longer produced after 1992. I acknowledge that this sample period is

[5] Ticker symbols of the firms that announced open market share repurchases in my sample were provided by the Thomson Financial Securities Data (TFSD). There were some discrepancies between these ticker symbol and those provided by CRSP. In such cases, by checking CRSP permanent numbers (PERMNO), CUSIP numbers, company names, relevant stock exchanges, and SIC codes across the CRSP data, the COMPUSTAT data, and TFSD, I verified the correct ticker symbols and used the correct ones.

not as recent as I want it to be. But, the TAQ (Trade and Quote) data that contain recent intraday data are simply not available to this author.

The second issue is the loss of many observations in the NASDAQ ISSM data, which can introduce a potential selection bias. It is possible that those missing quotation data are from small and relatively unknown companies with infrequently traded shares and presumably high bid-ask spreads. Surprisingly, firm size proxied by equity market capitalization is larger in the missing sample firms than in the included sample firms. That is, the NASDAQ intraday data used in my study are skewed to smaller market capitalization firms. However, the volatility decline, the main result of this paper, is not sensitive to different firm size proxied by market capitalization. Besides, the firm size of the included NASDAQ sample firms shows wide cross-sectional dispersion. The firm size ranges from 3 million dollars to 2.6 billion dollars with the mean market capitalization equal to 125 million dollars. More importantly, as will be shown in the empirical results sections to follow, the conclusions of this paper do not change whether I include the NASDAQ sample or not.

Moreover, to check the robustness of the results, in section 5, I expand the sample size to 1,385, very close to the original sample size of 1,399 that I started with. This increase in sample size is possible because in section 5 I use CRSP daily returns, instead of the ISSM data, to measure daily return standard deviations. Again, the results do not change with this expanded sample.

Sample descriptive statistics are provided in Table 1. Panel A shows the sample of size 978 based on the ISSM data, and this sample is used in section 4. Panel B shows the expanded sample of size 1,385 based on CRSP daily returns, and this expanded sample is used in section 5. 1990 is the most active year. In the expanded sample, there are 667 announcements in 1990. Out of the 1,385 announcements, 651 announcements are made by NYSE/AMEX firms and 734 are made by NASDAQ firms.

4. Empirical results

4.1. Univariate analyses

I examine changes in daily return standard deviations for +60 and - 60 trading day periods relative to day 0, the announcement day, and the univariate results are shown in Table 2. I explain variables used in this section and in subsequent sections as follows.

VOLAT (daily return standard deviation): To avoid artificial volatility created by bid-ask bounce, daily return standard deviations are measured by taking the midpoints of daily closing bid-ask quotes. Standard deviations of daily closing midpoints are computed for the pre-announcement 60 trading days and for the post-announcement 60 trading days, respectively.

EXCH (NYSE/AMEX or NASDAQ): There are numerous theoretical and empirical studies that explore differences across different exchanges or markets.[6] A very simple characterization for NYSE and AMEX (the New York Stock Exchange and the American Stock Exchange) will be that NYSE and AMEX are auction markets where a single specialist largely assumes the market-making responsibility for a share. On the other hand, NASDAQ (the National Securities Dealers Market) is a dealers' market where multiple dealers make the market for a share. In this paper, I examine potentially different volatility implications resulting from different market structures between NYSE/AMEX and NASDAQ. In multiple regression analyses in a later section, EXCH is dummy coded as 1 if the market is NASDAQ, and 0 otherwise.

Table 2 contains the results of paired t-tests (1), Wilcoxon signed-ranks tests (2), and sign tests (3) with respect to changes in daily return standard deviations. Differences (mean diff and median diff) are defined as post-announcement values minus pre-announcement values, and the mean difference, the median

[6] See Schwartz (1993) and Huang and Stoll (1996) for extensive literature review and institutional details.

difference, and the number of observations with positive signs are listed for each test. Significance levels are based on one-tailed tests in which *, **, *** denotes 10 %, 5 %, 1 %, respectively.

In Panel A (entire sample) of Table 2, the mean difference in daily return standard deviations between the pre-announcement period and the post-announcement period is very significant with the t-statistic equal to –3.35. The Wilcoxon signed-ranks test and the sign test also show that daily return standard deviations decrease significantly with p-values near zeroes.

In addition to median tests, I investigate individual data points searching for potential outliers. I find that the significant decline in daily return standard deviation is not driven by extreme values. Also, as a robustness check, I examine the pre-announcement period of day –65 through day –6 and the post-announcement period of day +6 to day +65 (day 0 = announcement day). The volatility declines are also significant, and I do not report the results here.

Panel B and Panel C of Table 2 show that the significant volatility decline is not limited to any one specific market, either NYSE/AMEX or NASDAQ. Daily return standard deviations decrease significantly both in NYSE/AMEX and in NASDAQ. This issue will be further examined in a multiple regression analysis in a later section.

In sum, the results in Table 2 support the *Volatility Decrease Hypotheses*: Daily return standard deviation decreases very significantly.

4.2. Control sample analysis

In this section, I perform a control sample analysis to test the robustness of the decrease in daily return standard deviation documented in Table 2. I examine whether this volatility decline is resulting from a market wide volatility decline around repurchase announcements or mean-reverting measurement errors

(volatility mean reversion).[7] If volatility also declines in a volatility-matched control sample, this will be evidence of the existence of a market wide volatility decline or volatility mean reversion, thus weakening the support for the *Volatility Decrease Hypotheses*.

I form a control sample of 978 observations that correspond to the 978 repurchase events in Panel A of Table 2. Similar to Kamara and Koski (2001), after acquiring intraday data for all non-repurchase firms from the ISSM tapes, I calculate daily return standard deviations, average percentage spreads, and average price levels (bid-ask midpoints) for the pre-announcement 60 trading day period for each firm.[8] This forms a base data set from which a control sample is constructed. Once this base data set is divided into two groups, the NYSE/AMEX group or the NASDAQ group, a control sample of size 978 is formed one by one based on three matching criteria in the following order: (1) daily return standard deviations, (2) average percentage spreads, and (3) average price levels. Since the purpose of this study is to examine the robustness of the volatility decline, daily return standard deviation comes first in the sorting order. If a tie up to three decimal places occurs based on the daily return standard deviation criterion, then the percentage spread criterion is used, and the same procedure is repeated until the tie is broken. Closely related to daily return volatility, the percentage spread is a liquidity measure commonly used to compare liquidity differences between different companies. Also, an inverse of this percentage spread is a proxy for firm size.[9] As there are more than 8,000 firms in the base data set, a tie up to three decimal places between repurchase events and control sample candidates occurs very frequently in both the return volatility match and the percentage spread match. Thus,

[7] Volatility mean reversion refers to the following phenomenon. An incidence of very high measured volatility can result from a positive measurement error. The next event (post-announcement event) or the next measurement error is more likely to realize lower in the error distribution. Thus, even if true volatility does not change, simple mean-reverting measurement errors can make measured volatility look significantly reduced after the announcement. A symmetric explanation can be given to an incidence of very low volatility.

[8] That is, these three measures were computed for each announcement date and for all the non-repurchase firms.

[9] The correlation coefficient between the inverse of the percentage spread and market capitalization is 0.63 in my sample.

the average price levels, the third criterion, often become tie-breakers. As a result, Table 3 exhibits an identical match up to 4 decimal places of the pre-announcement average daily return standard deviation between the repurchase sample and the control sample.

Table 3 shows that the decline in daily return standard deviation is a robust phenomenon significantly associated with open market share repurchases. Daily return standard deviation actually goes up significantly in the control sample, whereas in the repurchase sample, daily return standard deviation goes down significantly, as previously shown in Table 2. The increase in daily return standard deviation in the control sample seems to be consistent with the popular belief that open market share repurchase announcements are usually made when the overall market is going down with possibly increasing volatility. At these market downturns, volatility goes down for share buyback firms, whereas volatility continues to increase for non-share buyback firms. The unpaired mean difference test (1) and the (unpaired) Wilcoxon rank sum test (2) show significance of this difference between the repurchase sample and the control sample.[10] Thus, the evidence of the control sample analysis in this section suggests that the significant decrease in daily return standard deviation in the repurchase sample is neither a market wide volatility effect nor a spurious result of volatility mean reversion.[11] This extends further support for the *Volatility Decrease Hypotheses*.

4.3. Buyback Trading Hypothesis vs. Reduced Growth Option Hypothesis

[10] I also examined changes in the range. The range is defined as (the largest value – the smallest value), and the results are consistent with the changes in daily return standard deviations reported in Table 3. In the repurchase sample, the range goes down, whereas in the control sample, the range goes up.

[11] I divided the sample into quintiles based on the magnitude of pre-announcement daily return standard deviations. It is observed that low volatility events tend to become high volatility events and vice versa. However, mean differences between the repurchase and the control sample remain highly significant in four out of the five quintiles. Volatility tends to mean-revert, but this does not explain the volatility decline documented in this study.

In the preceding sections, significance of the volatility decrease with respect to open market share repurchases was established, thus supporting the *Volatility Decrease Hypothesis*. In this section, I investigate which of the two versions of the *Volatility Decrease Hypotheses*, the *Buyback Trading Hypothesis* or the *Reduced Growth Option Hypothesis*, explains this significant volatility decline.

Whether firms buy back their shares actively or not is important for the test of the *Buyback Trading Hypothesis*. Thus, I introduce INTENS, a variable that estimates repurchase firms' actual buyback trading intensity.

Different from tender offer repurchases, open market repurchase managers have substantial discretion as to how many shares to buy back, when to buy back, and whether to buy back at all. Regulatory provisions, SEC Rule 10b-18 in particular, governing open market share repurchases, contribute to this flexibility.[12] SEC Rule 10b-18 does not require open market repurchase firms to file such information as the period of the repurchase, the number of shares repurchased, and the repurchase prices with the SEC (see Appendix for an overview on SEC Rule 10b-18). SEC Rule 10b-18 effectively relieves repurchasing firms of the reporting and disclosure duties that usually accompany major corporate events.[13] This makes it difficult

[12] Jaganathan, Stephens, and Weisbach (2000) point out this inherent flexibility. Also, Guay and Hartford (2000) present evidence consistent with this.

[13] In case of tender offer repurchases, the timing, the amount, and the price (range) are usually pre-determined. Although open market share repurchase announcements usually contain the approximate period and the amount of share repurchases, these announcements are seldom binding. Often, managers of a repurchase firm have discretion as to when and how many shares to buy back. In fact, they could completely forgo the entire repurchase program. This feature of open market share repurchase is modeled as an exchange option in Ikenberry and Vermaelen (1996). This flexibility comes in part from the very nature of open market share repurchases in that, different from tender offer repurchases, open market share repurchases are executed in the market while it is open. This flexibility, however, results largely from SEC Rule 10b-18 that provides disclosure exemption and safe harbor to open market share repurchase firms. This is in stark contrast to relatively stringent reporting and disclosure requirements that usually accompany other corporate

to track firms' actual buyback activities.[14] How much and when firms actually buy back are essential pieces of information in light of the *Buyback Trading Hypothesis* that relates firms' actual buyback trading activity to return volatility declines.

I use the Statement of Cash Flows item called 'Purchases of Common and Preferred Stock' to measure INTENS, the estimate for actual open market share reacquisition. This is the measure very similar to the ones adopted by Stephens and Weisbach (1998), Chan, Ikenberry, and Lee (2001), and Grullon and Michaely (2002). Alternative to the Purchases of Common and Preferred Shares, Treasury Stock or the number of outstanding shares can be used, but the extensive use of stock options make these data items significantly biased. Allen and Michaely (2002) discuss alternative measures and recommend the Statement of Cash Flow item.

Year-to-date dollar amounts for this item are available in Compustat (quarterly data item number 93). Using this information, first, a net dollar amount spent on share repurchase is calculated for the fiscal quarter that immediately follows the announcement quarter. This net dollar amount is subsequently divided by the average of the 3 monthly closing prices of the fiscal quarter to estimate the number of shares repurchased.[15] The variable INTENS is then computed by dividing the estimated number of common shares

---

events including tender offer repurchases and insider trading activities. I provide an overview on SEC Rule 10b-18 in Appendix.

[14] Kim and Varaiya (2003) argue that the lax disclosure requirements in the U.S. can create room for a conflict of interest.

[15] Without the knowledge of the actual prices firms paid to repurchase shares, INTENS is an imperfect measure. Besides, 'Purchases of Common and Preferred Stock' include preferred shares repurchased and common shares repurchased via private negotiation. This data item is an aggregate measure of many kinds of transactions. Compustat provides the list of items included in the Purchases of Common and Preferred Stock. They are (1) conversion of class A, class B, and special stock into common stock, (2) conversion of preferred stock into common stock, (3) purchase of treasury stock, (4) repurchase of warrants when combined with repurchase of common or preferred stock, (5) retirement

repurchased by the post-announcement 60 day average of daily trading volume.[16] Daily trading volume is defined as the number of shares traded in a given day. INTENS1 – INTENS3 represent three subgroups, in which INTENS1 is the subgroup with the lowest buyback intensity and INTENS3 the highest.[17]

The *Reduced Growth Option Hypothesis* suggests that a volatility decline is not a result of buyback trading activity of a firm. Instead, volatility goes down as a firm moves from a growth phase to a more mature phase and experiences reduced growth options. To test whether repurchase firms indeed face reduced investment opportunity sets or reduced growth options after the announcements, I examine changes in three measures as follows.

CAPEXP: ratios of capital expenditures to total assets.

STDINC: standard deviations of operating incomes.

MKTBK: ratios of market value of equity to book value of equity.

These variables are similar to those used in Jaganathan, Stephens, and Weisbach (2000) and Grullon, Michaely, and Swaminathan (2001). If a firm becomes more mature with reduced growth options, the firm is likely to (i) decrease Capital Expenditure, (ii) experience less volatile cash flows, or Operating Incomes, and (iii) face smaller market value of equity relative to book value of equity. Relative to year 0 (announcement

---

or redemption of common/ordinary stock, (6) redemption of preferred stock, and (7) retirement or redemption of redeemable preferred stock.

[16] The variable INTENS was also calculated by dividing the estimated number of shares repurchased by the number of shares outstanding. The results are very similar and are not reported.

[17] As will be discussed in the following section, most of the observations in INTENS1 are zeroes. Because of those zeros in INTENS1, many ties occurred in forming quintiles, making the number of observations in quintile 1 very large out of proportion. For this reason, observations were divided into 3 sub-groups (INTENS1 - INTENS3) of about equal size instead of quintiles.

year), years –2 to –1 and years +1 to +2 are examined. For CAPEXP and MKTBK, Compustat Annual Data Files are used, and for STDINC, Compustat Quarterly Data Files are used. The market value of equity is computed by multiplying the fiscal year end price by the fiscal year end number of shares outstanding.[18]

Table 4 presents evidence that supports the *Buyback Trading Hypothesis*. In INTENS1, the sub-group in which buyback trading intensity is the lowest, the change in daily return standard deviation is insignificant. On the contrary, in INTENS2 and INTENS3, where buyback trading intensity is higher, daily return standard deviation goes down significantly.[19] Compared to INTENS1, the magnitude of the decrease is larger and more significant in INTENS2 and INTENS3 with the net declines of 0.0024 and 0.0026, respectively. These changes in standard deviation represent 8.7 % and 11.1 % declines from the pre-announcement level. The t-statistic for INTENS3 is the largest, equal to –3.27.

A close examination of INTENS1 reveals that, for most of the observations in this sub-group, the estimates for repurchased shares are zero.[20] This indicates that the firms in this sub-group did not buy back their shares at all in the fiscal quarter that immediately followed the announcement quarter. The result in this panel shows that the more intensely firms buy back their shares, the more significantly daily return standard deviation goes down. Such a result is predicted by the *Buyback Trading Hypothesis*, but it is not predicted by the *Reduced Growth Option Hypothesis*.

---

[18] Other variables used in existing studies for measures of firm maturity include levels of Operating Incomes and Cash and/or Cash Equivalents. I did not use these measures because it is not obvious whether reduced growth options will necessarily increase or decrease profitability, income levels, or cash levels.

[19] I also examined changes in the range for each of INTENS1, INTENS2, and INTENS3. The range is defined as (the largest value – the smallest value). Consistent with the changes in daily return standard deviations reported in Table 4, in INTENS2 and INTENS3, the range goes down, whereas in INTENS1, the range actually goes up.

[20] As previously mentioned, because of these zeros in INTENS1, observations were divided into 3 sub-groups (INTENS1 - INTENS3) of about equal size instead of quintiles.

Note that 660 observations for INTENS estimates are smaller than 978 overall sample observations. This is because of the missing values in Purchases of Common and Preferred Stock of Compustat Quarterly Data Files. This missing value problem is not my sample-specific. Missing values are similarly noted in Chan, Ikenberry, and Lee (2001) who report about 25 % loss of observations with the use of the same quarterly data item. In the Compustat data, the missing observation problem is more severe in Quarterly Data Files than in Annual Data Files, and I use quarterly values to estimate actual buyback trading intensity in this study.

With respect to the *Reduced Growth Option Hypothesis*, Table 5 shows changes in the aforementioned three variables (CAPEXP, STDINC, and MKTBK) for the repurchase sample and also for the volatility-matched control sample used in the previous section.

Table 5 shows that CAPEXP does go down in the repurchase sample, and this tends to suggest that the firm is getting more mature. However, CAPEXP also goes down significantly in the control sample, and the difference between the repurchase sample and the control sample is insignificant. With respect to Operating Incomes, they should be less volatile if a firm gets more mature. But STDINC actually goes up in the repurchase sample, whereas in the control sample, the increase is insignificant. Similarly, MKTBK goes up weakly significantly in the repurchases sample, while the ratio increases insignificantly in the control sample. In none of the three measures are the differences between the repurchase and the control sample significant. In sum, the null hypothesis that firm maturity remains unchanged in the repurchase firms cannot be rejected. Thus, I find no support for the *Reduced Growth Option Hypothesis*.

Consistent with this result, previous studies find that firms of all types conduct open market share repurchases, including small and young firms with many growth options. According to Fama and French (2001), many small companies or newly listed companies adopt open market share repurchases extensively. Jaganathan, Stephens, and Weisbach (2000) and Guay and Harford (2000) present evidence that firms with more volatile cash flows or more temporary cash flow shocks are more likely to employ stock repurchases. Also, Grullon and Michaely (2002) document extensive use of share repurchases by young firms as well as well-established large firms.

In this section, the *Buyback Trading Hypothesis* is compared with the *Reduced Growth Option Hypothesis*, and the results support the *Buyback Trading Hypothesis*. In sum, evidence shows that (i) higher buyback trading intensity is associated with a larger volatility decline and that (ii) changes in maturity of repurchase firms are not significant. Next, I turn to multiple regression analyses to further investigate the relation between buyback trading intensity and the volatility decrease.

4.4. Multiple regression analysis

4.4.1. Independent variables

The result in the preceding section showed a positive relation between actual buyback trading intensity (INTENS) and the decrease in daily return standard deviation (the *Buyback Trading Hypothesis*). In this section, the following multiple regression is performed to further examine this relation between the return volatility decline and buyback trading intensity, while controlling for changes in other variables.

$$\Delta VOLAT_i = b_0 + b_1*\Delta VOLUME_i + b_2*\Delta MKTVOLAT_i + b_3*\Delta\%SPREAD_i + b_4*VOLAT_i + b_5*EXCH_i + b_6*INTENS_i + \varepsilon_I \quad (1)$$

Changes in daily return standard deviations (ΔVOLAT) are regressed on ΔVOLUME, ΔMKTVOLAT, Δ%SPREAD, VOLAT, EXCH, and INTENS. Δ denotes the post-announcement value minus the pre-announcement value, and I explain new variables as follows. Other variables are as defined previously.

ΔVOLUME (change in trading volume): The total number of shares traded per day is defined as daily trading volume, and the daily figures are averaged across pre-announcement 60 trading days and post-

announcement 60 trading days, respectively. ΔVOLUME is defined as (the post-announcement 60 trading day average minus the pre-announcement 60 trading day average). The unit is a thousand shares.

Δ%SPREAD (change in the percentage spread): The percentage spread is defined as (the ask price minus the bid price) / (the spread midpoint), in which the spread midpoint is (the ask price plus the bid price) / 2. I take daily averages of percentage spreads, and then I average these daily values for +60 days and –60 days, respectively, to determine Δ%SPREAD.

ΔMKTVOLAT (change in market volatility): The market index used to calculate market volatility is the CRSP dividend adjusted value weighted index. Standard deviations of the index daily returns for pre- and post-announcement 60 trading days are used to compute ΔMKTVOLAT.

VOLAT and *EXCH* are the same variables as introduced previously except for the followings. In this section, VOLAT is the pre-announcement 60 day standard deviation, and EXCH is a dummy variable that equals 1 if the relevant market is NASDAQ, and 0 otherwise (NYSE/AMEX).

ΔVOLUME enters the regression equation as an independent variable because return volatility is a function of trading volume. According to Karpoff (1987), there is abundant empirical evidence that the magnitude of price changes is positively correlated with trading volume. ΔMKTVOLAT is included to control for the change in market-wide volatility. Copeland and Galai (1983) present a theory in which the bid-ask spread is a positive function of return variance. Thus, the change in percentage bid-ask spreads, Δ%SPREAD, is included to account for volatility changes associated with percentage spread changes, if

any.[21] To control for volatility mean reversion, I also use VOLAT, daily return standard deviation for pre-announcement 60 trading days, as an independent variable. EXCH is used to determine potential differences of volatility changes between NYSE/AMEX and NASDAQ.

Finally, I include INTENS, the estimate for actual buyback trading intensity, in the regression. This variable is particularly important in testing the *Buyback Trading Hypothesis*. INTENS, as explained in the previous section, is obtained by dividing the estimated number of shares repurchased (Purchases of Common and Preferred Stock) by average daily trading volume.

4.4.2. Regression results

Table 6 provides the regression results. In Table 6, all the independent variables except EXCH are statistically significant, and the R^2 is 0.39. To correct the problem of heteroskedasticity, White's covariance matrices are used to calculate consistent standard errors. The White heteroskedasticity test rejects the null hypothesis of no heteroskedasticity with the p-value near zero. The regression results, however, are not sensitive to the use of White consistent standard errors. For instance, INTENS, an important variable for the *Buyback Trading Hypothesis*, is significant with the p-value equal to 0.0413 even when White's standard errors are not used. In Table 6, I report the results with White's consistent standard errors.

As expected, ΔVOLUME, ΔMKTVOLAT, and Δ%SPREAD are positively and significantly associated with ΔVOLAT. Daily return standard deviation moves in the same direction as trading volume, market volatility, and percentage spreads. VOLAT is an important variable as it captures the effect of volatility mean reversion. Not surprisingly, VOLAT is very significant. EXCH is insignificant, and this is

[21] Kim (2003) examines potential cross sectional differences of liquidity effects associated with open market share repurchases. The evidence in Kim (2003) suggests that liquidity effects of the share repurchase are insignificant both in terms of overall measures and in terms of cross sectional measures.

consistent with the univariate result in Table 2 that the significant volatility decline is not limited to one specific market, either NYSE/AMEX or NASDAQ.

An important empirical result for this paper comes from the examination of INTENS, the estimate for actual buyback trading intensity. INTENS, a variable crucial to the *Buyback Trading Hypothesis*, is indeed very significant with the p-value 0.0054. In short, the result of the multiple regression analysis shows that actual buyback trading activity is significantly associated with the decrease in daily return standard deviation. This reinforces the univariate finding in a previous section.[22]

4.5. Price changes and buyback trading intensity

The buyback trading pattern stated in the *Buyback Trading Hypothesis* is that repurchase managers have a tendency to engage in buyback trading more actively when the price realizes in the lower tail of the price distribution that the managers have in mind. In this section, I examine this tendency, given the previous results supporting the *Buyback Trading Hypothesis*.

As an indirect way of testing this tendency, average prices (closing bid-ask midpoints) are examined before and after the announcement in Table 7. It shows price changes for the entire sample (Panel A) and for each INTENS group (Panel B). In Panel A, the post-announcement average price level is lower than the pre-announcement level. The decrease in the price level is statistically significant at the 5 % level with the amount of the decrease equal to 23 cents.[23,24] Panel B shows a pattern that is consistent with the firm's

[22] An examination of correlation coefficients among independent variables indicates that multicollinearity is not a serious problem in this regression, and I do not report the correlation coefficient table. The correlations are largely small for all the regressors except for 0.32 between VOLAT and EXCH. The regression results, the significance of the coefficient for INTENS, in particular, are not sensitive to the inclusion or exclusion of EXCH.

[23] As well documented in previous research, the daily return reaction at the announcement, for which I do not report the details, is positive and highly significant with the t-statistic equal to 10.88. In all INTENS groups, increases in average

tendency to buyback when the price realizes in the lower tail of the distribution. The price decrease is the largest and the most significant in INTENS3, the group with the highest buyback trading intensity. On the other hand, in INTENS1 in which buyback trading intensity is the lowest, the average price drop is the smallest and insignificant.

To view this tendency graphically, Figure 2 plots average daily prices across day -60 through +60 (day 0 = the announcement day) for the entire sample (Total), for INTENS1, for INTENS2, and for INTENS3, respectively. Average daily prices in a given day are computed by taking the average of all daily prices (closing bid-ask midpoints) of all the incidents belonging to each group. For INTENS3, the downward price drift is observed. This contrasts with price movements in INTENS1 and in INTENS2, where prices drift upward after day 0. Price movement patterns shown in Figure 2 are consistent with the buyback tendency stated in the *Buyback Trading Hypothesis*.

To further examine the relation between price changes and firms' buyback trading intensity, in Panel C of Table 7, I calculate correlation coefficients between the INTENS variable and price changes for the

---

return after the announcements are highly significant. The reason for the fall in the average price level is because of a decline in price before the announcement.

[24] (1) The papers that document positive returns associated with open market share repurchases include Dann (1981), Bartov (1991), Comment and Jarrell (1991), Franz, Rao, and Tripathy (1995), Ikenberry, Lakonishok, and Vermaelen (1995), Ikenberry and Vermaelen (1996), Ho, Liu, and Ramanan (1997), Barth and Kasznik (2000), Ikenberry, Lakonishok, and Vermaelen (2000), Grullon and Michaely (2000), Grullon and Ikenberry (2000), and Hataketa and Isagawa (2001).

(2) The papers that document positive returns associated with tender offer repurchases (or both tender offer repurchases and open market repurchases) include Masulis (1980), Dann (1981), Lakonishok and Vermaelen (1990), Dann, Masulis, and Mayers (1991), Hertzel and Jain (1991), and Hataketa and Isagawa (2001).

(3) The theoretical papers that suggest positive returns following share repurchases include Ofer and Thakor (1987), Brennan and Thakor (1990), Hausch and Seward (1993), Lucas and McDonald (1998), Isagawa (2000), and Isagawa (2001).

post-announcement period. Recall that most of the firms in INTENS1 did not buy back their shares at all during my sample period after they announced buyback programs. To measure the post-announcement price change for each firm j, I use the following formula: $\Delta PRICE_{Dj} = \left(\frac{p_{Dj} - p_{-1j}}{p_{-1j}} \right)$, in which D stands for day D relative to day 0, the announcement day. Thus, p_{30j}, p_{40j}, and p_{50j} indicate the price of firm j at day 30, day 40, and day 50, respectively, and $\Delta PRICE_{30j}$ measures the percentage change in prices of firm j from the one day before the announcement day to the 30th day after the announcement day. Each of the three columns of Panel C shows correlation coefficients between ΔPRICE and INTENS for D = 30, D = 40, and D = 50. I arbitrarily choose these three post announcement days to show an overall trend. Results based on other D values are very similar to what I present in this table, and I do not report them here.

In Panel C of Table 7, INTENS (raw number) is the same INTENS variable as previously defined, and INTENS (category) is a category variable, in which I assign 1, 2, and 3 for INTENS1, INTENS2, and INTENS3, respectively. Panel C shows that correlation coefficients between ΔPRICE and INTENS are in the range of –0.1150 to –0.2218, indicating a significantly negative relation between a price change and buyback trading intensity. That is, as the price drops more or the price increases less, buyback trading intensity gets bigger.

Averages of price changes (averages of ΔPRICE) are listed for each INTENS group in Panel D of Table 7. Average price changes are the largest in INTENS1 for all D values, suggesting that prices on average go up the most in this group. On the other hand, in INTENS3, a group with the highest buyback trading intensity, average price changes are the smallest in every case.

Without the knowledge of the price distributions that managers have in mind, the buyback tendency postulated in the *Buyback Trading Hypothesis* cannot be exactly verified. The evidence presented in this section therefore is suggestive rather than conclusive of the tendency that managers engage in repurchase trading when the price falls in the lower tail of the distribution. Nevertheless, the results in Table 7 and

Figure 2 show a persistent pattern that is consistent with this buyback tendency depicted in the *Buyback Trading Hypothesis*.

5. Longer term analyses

An important finding in the previous section is that daily return volatility decreases significantly only when firms actually engage in buyback trading. Both the univariate and multiple regression results suggest that return volatility does not go down if the firms do not actively repurchase shares even after the firms announce buybacks. Only when buyback trading intensity goes up, return volatility goes down.

However, a question remains unanswered: Whether or not return volatility goes back up if firms stop buying back shares. If the volatility decrease is a temporary effect of buyback trading, then the volatility level should return to the previous level when firms stop buying back shares. Or, if the significant decrease in return volatility is a permanent effect related to buyback trading, then return volatility should remain at a decreased level even after firms discontinue repurchasing shares.

To investigate this question, I perform longer term analyses in this section. Previously, I examined changes in daily return standard deviations from the pre-announcement 60 day level to the post-announcement 60 day level, using closing bid-ask spread midpoints from the ISSM data. To measure actual buyback trading intensity (INTENS), I considered only one fiscal quarter after the announcement quarter. In this section, I consider four post-announcement fiscal quarters, in which INTENS is measured quarter by quarter. Since the ISSM data are no longer available after 1992, a significant loss of observations will occur with the longer term analysis.[25] Thus, instead of using the ISSM data, I use the CRSP daily return series to compute changes in daily return standard deviations for the announcement quarter and the following four quarters.

[25] Also, the ISSM NASDAQ data were produced only for the period of 1990 – 1992.

The reason I consider the one-year (four quarters) period following the announcement is because a typical buyback program can last up to one year or more. In fact, out of the 961 firms that actually bought back shares in the first fiscal quarter that immediately followed the announcement quarter, 400 firms also bought back shares in the fourth quarter, or the last quarter of the one-year period.

In Table 4 of the preceding section, the relationship between the return volatility decline and buyback trading activity is shown. The validity of this relationship will be strengthened, if this relationship is also observed with return volatility measured on the CRSP returns instead of the ISSM bid-ask midpoints. Otherwise, the association between buyback trading and return volatility will be weakened, as this association is attributable to a specific data set. To investigate this possibility, Table 8 is tabulated the same way as Table 4 was. INTENS is identically measured using 'Purchases of Common and Preferred Stock' for the post-announcement fiscal quarter, and standard deviations are measured for the pre-announcement 60 trading days and the post-announcement 60 trading days, respectively. The only difference between Table 8 and Table 4 is that CRSP daily returns are used to compute daily return standard deviations in Table 8, whereas in Table 4, the ISSM daily closing bid-ask midpoints were used to compute daily return standard deviations.

The result in Table 8 confirms the result in Table 4. The overall decrease in daily return standard deviation is significant in Panel A of Table 8, as it was in Panel A of Table 4. Note that the number of observation (n=1385) of Table 8 is much larger than that of Table 4 (n=978) as the missing observation problem is much less severe in the CRSP data than in the ISSM data. The number of repurchase announcements of my original sample is 1,399. Like the result in Panel B of Table 4, Panel B of Table 8 shows that in INTENS3, a subgroup with the highest buyback trading intensity, the volatility decrease is the most significant, whereas in INTENS1, in which buyback trading intensity is the weakest, the volatility decline is insignificant.

Given the one-quarter result of Table 8 that is qualitatively the same as the result in Table 4, I proceed with longer term analyses that examine four post-announcement fiscal quarters and an announcement fiscal quarter.

As before, I estimate the numbers of shares repurchased using 'Purchases of Common and Preferred Stock for each of the four post-announcement fiscal quarters. Then, the buyback trading intensity variable, INTENS, is obtained by dividing these estimated numbers of shares repurchased by quarterly averages of daily trading volume. Daily trading volume is the average number of shares traded in a given day, and this time, I obtain trading volume data from the CRSP data, not the ISSM tapes. Also, I compute standard deviations of CRSP daily returns for each quarter.

In Table 9, $\Delta VOLAT_T$ is the difference of daily return standard deviations between a quarter and the immediately preceding quarter: $\Delta VOLAT_T = VOLAT_T - VOLAT_{T-1}$ (T=1,2,3,4). $VOLAT_0$ is daily return standard deviation of the announcement quarter. $\Delta INTENS_T$ is the difference of buyback trading intensity between a quarter and the immediately preceding quarter: $\Delta INTENS_T = INTENS_T - INTENS_{T-1}$ (T=1,2,3,4). $INTENS_0$ is buyback trading intensity of the announcement quarter, and $INTENS_0$ is assumed to be zero.

In Panel A, there are 5,026 ΔVOLAT's throughout the five quarter period (the announcement quarter and the four post-announcement quarters). Panel A shows the overall decreasing tendency of return volatility. That is, for the four-quarter period after the announcement, return volatility tends to decrease significantly quarter after quarter. This is consistent with the previous finding that return volatility decreases significantly for the post-announcement 60 trading day period.

In Panel B, ΔINTENS is sub-grouped into quintiles from the smallest to the largest values. In Quintile 1 with the lowest 20 % observations of $\Delta INTENS_T$, all the values are in fact negative.[26] That is, in Quintile 1, buyback trading intensity is actually reduced from the preceding quarter. In Quintile 5, on the other hand, all the values are positive, indicating that buyback trading intensity is raised from the previous quarter.

[26] As is the case with the previous results, the total number of observations in Panel B (n=3793) is much less than that of Panel A (n=5026). This is because there are many missing observations in 'Purchases of Common and Preferred Stock', the Compustat data item number 93.

The results in Panel B confirm the previous result that it is the actual buyback trading intensity that is significantly associated with the decrease in daily return standard deviation. The significant negative relationship between buyback trading intensity and the volatility change is illustrated by two extreme cases, Quintile 1 and Quintile 5. In Quintile 1, daily return standard deviations actually increase significantly as buyback trading intensity decreases, whereas in Quintile 5, daily return standard deviations decrease significantly as buyback trading intensity increases.

Return volatility decreases significantly also in Quintile 3, and the interpretation of this result is not entirely straightforward. All the 1,228 $\Delta INTENS_T$ values in this quintile are zeroes, and the values of $INTENS_{T-1}$ are also zeroes ($\Delta INTENS_T = INTENS_T - INTENS_{T-1}$).[27] This means that return volatility still tends down, when firms do not buy back shares. Note that the magnitude of daily return standard deviation of the preceding quarter ($VOLAT_{T-1}$) is the largest in Quintile 3 among all the quintiles. Thus, it is possible that the volatility decline in this quintile is a result of volatility mean reversion. In the following multiple regression analysis, I control for mean-reverting return volatility, and the results are shown in Table 10.

Similar to Table 6 of the previous section, in Table 10, $\Delta VOLAT_T$ is regressed on a constant term, $\Delta INTENS_T$, $\Delta VOLUME_T$, and $VOLAT_{T-1}$. $VOLUME_T$ is the quarterly average of CRSP daily trading volume, and $\Delta VOLUME_T = VOLUME_T - VOLUME_{T-1}$ (T=1,2,3,4), where $VOLUME_0$ is average daily trading volume of the announcement quarter. The trading volume measurement unit is 1,000 shares. $VOLAT_{T-1}$, daily return standard deviation of the preceding quarter, is the volatility mean reversion control variable. T-statistics in Table 10 are based on White heteroskedasticity-consistent standard errors, and the corresponding p-values are based on two-tailed tests.[28]

Like the result in Table 6, in Table 10, the coefficient for $\Delta VOLUME_T$ is significantly positive, and the coefficient for $VOLAT_{T-1}$ is significantly negative. Most importantly, $\Delta INTENS_T$ is significantly

[27] Because of all these zeroes, there are many ties, and thus this quintile has many more than 20 % of the total observations.

[28] Results are not sensitive to the use of White standard errors.

negatively related to $\Delta VOLAT_T$. This negative relation between buyback trading intensity and the volatility change is consistent with the univariate result in Table 9. And also, this result is consistent with the results in the previous sections.

Throughout this paper, evidence presented in univariate, multivariate, short term, and longer term analyses consistently supports that it is the actual buyback trading intensity that is significantly negatively associated with the change in return volatility. When buyback trading intensity goes up, return volatility goes down, and when buyback trading intensity goes down, return volatility goes up. Simply put, volatility goes down only when the firms intensely buy back.

6. Economic significance of the return volatility decline

In the preceding sections, ample evidence has been documented for the relation between actual buyback trading activity and the return volatility decline. As mentioned in the introduction, examining changes in return volatility or total risk is important because return volatility matters to undiversified investors, arbitragers, and options holders, and also because return volatility affects risk that is priced, or systematic risk. In this section, to examine the economic significance of the statistically significant return volatility decline, first, I present simple numerical examples based on the Black-Scholes option formula to illustrate how much option price changes as a result of a decrease in daily return standard deviation. Second, I investigate changes in systematic risk as measured by CAPM beta.

6.1. Changes in Black-Scholes option prices

In Table 4, daily return standard deviation goes down by 11.1 % for INTENS3, the group with the highest buyback trading intensity. In this section, I address how the 11.1 % decline in standard deviation is

translated into changes in option prices, using the Black-Scholes option formula. I illustrate this by providing simple numerical examples.

Suppose that there are one European call option and one European put option with the exercise price $21. The arbitrary choice of $21 is based on the average pre-announcement price level for the repurchase sample. Given that daily return standard deviations are measured over a quarter period and buyback trading intensity is estimated on a quarterly basis, assume that the remaining term to maturity of the options is 65 trading days. Assume further that the risk-free rate is 5 % per year, the dividend yield is zero, and the current daily return standard deviation is 0.0271, the pre-announcement average. Following Hull (1997), I multiply 0.0271 by the square root of 252, the number of trading days in a year, to annualize the daily return standard deviation value.

Assume that daily return standard deviation decreases by 10 %. This is a conservative value compared to 11.1 %, the average % decline shown in Table 4. If the current share price is $21, that is, if the options are at-the-money, then the 10 % decline in daily return standard deviation results in a 9 % decrease in the call price and an 11 % decrease in the put price. I conclude that the decreases of these magnitudes are economically significant. If the current price is $26, then the decreases in the options prices are 1 % for the call and 33 % for the put. If the current share price is $16, then the decreases are 38 % and 1 %.

These numerical examples, although simplified with arbitrary assumptions, show that the return volatility decline documented in this study is economically significant as well as statistically significant. Return volatility goes down for those firms that actively buy back the shares, and this volatility decline significantly affects option prices on these firms' shares.

6.2. Changes in CAPM beta

In this section, I examine the economic significance of the return volatility decline by examining changes in systematic risk. I measure systematic risk by CAPM beta. To compute CAPM beta, CRSP daily returns are regressed on a constant term and CRSP distribution-included value weighted return indexes.

CAPM beta's are calculated for one calendar year before and after the announcements, respectively. The post-announcement one year period starts on the first day of the fiscal quarter that immediately follows the announcement fiscal quarter, and the pre-announcement one year period ends on the last day of the fiscal quarter that immediately precedes the announcement fiscal quarter. To estimate buyback trading intensity, just like section 5, I examine four fiscal quarters after the announcement quarter.

The results show that 169 out of total 1,385 announcements are followed by no actual share repurchase at all for the post-announcement one year period. In other words, $INTENS_T$'s for the four quarters for these 169 announcements are mostly zeroes. Panel A of Table 11 tabulates beta changes for these 169 announcements. The panel shows an increase in beta. But the beta increase is not significant.

To compare this with the beta change from announcements followed by active share repurchase activity, in Panel B of Table 11, I select 169 announcements with the highest buyback trading intensity. In contrast with Panel A, Panel B shows that CAPM beta decreases significantly.[29] The paired mean difference test and the Wilcoxon Signed-Rank test show that the beta decline is significant when firms buy back shares very intensely. This result again supports the *Buyback Trading Hypothesis*.

Note that the magnitude of beta in Panel A (No buyback) is larger than that of Panel B (Intense buyback) in Table 11. To see the effect of buyback trading intensity on CAPM beta while holding the pre-announcement beta level constant, in Table 12, I run multiple regressions with $BETA_{PRE}$ (the pre-announcement beta) as one of the regressors.

Panel A of Table 12 shows that buyback trading intensity is significantly negatively related to the beta change. Changes in beta, $\Delta BETA$ ($=BETA_{POST} - BETA_{PRE}$), are regressed on a constant term, $BETA_{PRE}$, and INTENS_DUM. INTENS_DUM is a dummy variable for the two 169-announcement groups in Table

[29] According to Denis and Kadlec (1994), the CAPM beta estimate becomes downward-biased because a share repurchase induced trading volume decline leads to an increase in trading friction and price adjustment delays. However, I do not find any evidence that the changes in trading volume and other liquidity measures are significant. See Kim (2003) for the examination of liquidity changes with respect to open market share repurchases.

11. This dummy variable is equal to zero if an observation belongs to the no-buyback group of 169 announcements, and equal to one if an observation belongs to the intense-buyback group of 169 announcements. The t-statistic is – 4.51 for the coefficient of INTENS_DUM.

In Panel B of Table 12, ΔBETA (=$BETA_{POST}$ – $BETA_{PRE}$) is regressed on a constant term, $BETA_{PRE}$, and INTENS_YR. INTENS_YR is a raw yearly estimate, not a dummy variable, for buyback trading intensity for the post-announcement one year period for the whole sample, and is computed by dividing the estimated number of shares repurchased by the average daily trading volume, just as in the previous sections. Again, the coefficient for INTENS_YR is significant, confirming the result in Panel A.

The results of this section for changes in CAPM beta are exactly in line with the results for changes in daily return standard deviations in the preceding sections and thus, consistent with the implications of the *Buyback Trading Hypothesis*. If firms repurchase shares actively, beta goes down significantly, but if the firms do not buy back shares, then beta does not decrease.

The beta decline documented in this paper is also consistent with the findings of Bartov (1991). In Bartov (1991), it is the announcement that conveys the information of a systematic risk reduction.

My study offers deeper understanding of the CAPM beta decrease. My study connects the actual buyback trading activity, not the announcement itself, to the CAPM beta decline as well as the return volatility decline. That is, CAPM beta decreases only when firms engage in buyback trading actively. Recall the results of the examination of the *Reduced Growth Option Hypothesis*. The results suggest that a reduction in growth options or investment opportunity sets is not what is happening with respect open market share repurchases. There is no evidence that a repurchase-announcing firm moves into a more mature phase and that this increase in firm maturity leads to a decrease in systematic risk. Evidence throughout this paper consistently supports the *Buyback Trading Hypothesis* that it is only when firms actually engage in buyback trading actively that return volatility and CAPM beta go down significantly.

7. Conclusion and future research

This paper documents significant evidence that return volatility, as measured by daily return standard deviation, decreases as open market share repurchase firms actually engage in active buyback trading. The volatility-matched control sample analysis shows that this volatility decline is not a result of either a market wide volatility decline or volatility mean reversion. The results throughout this paper consistently show that buyback trading intensity, as defined by the number of shares repurchased divided by average trading volume, is significantly negatively associated with return volatility changes.

Return volatility is a previously unexplored area of share repurchase research. Yet, the issue deserves attention because changes in return volatility are important to underlying option holders, arbitrageurs, and investors who hold undiversified portfolios. Most of all, it can affect systematic risk. In addition to the return volatility decline, I find a significant decline of CAPM beta. Consistent with the return volatility results, CAPM beta decreases significantly only when firms actively buy back shares.

Extant research offers several explanations as to why firms undertake open market share repurchases. This study present results that are consistent with the price support explanation. Evidence suggests that an open market share repurchase firm, by actively buying back its own shares when the share price falls, supports its price and reduces its return volatility. When the firm reduces its buyback trading intensity or discontinues buyback trading, return volatility increases or goes back up.

An interesting observation on buyback trading activity of a repurchase firm is possible. Buyback trading activity of a repurchase firm is similar to market-making activity or market stabilization activity of a lead underwriter in the equity-issuance aftermarket. According to Aggarwal (2000) and Ellis, Michaely, and O'Hara (2000), the most dominant form of IPO market support activity is the aftermarket short covering activity or the share buyback activity by a lead underwriter. A lead underwriter almost always oversells the shares, usually by 15 % of the original offering amount. If the IPO becomes successful, or if the newly traded stock price increases, then the overallotment option or the Green Shoe option is exercised to cover the initial short position.

If the IPO becomes unsuccessful, or if the price deteriorates, then the lead underwriter covers its initial short position by buying back the newly traded shares (aftermarket short-covering). The poorer is the performance of the IPO, the more shares the lead manager tends to repurchase. From this, I find that price support activity through share repurchases by a lead underwriter in the IPO aftermarket resembles buyback trading activity by an open market share repurchase firm. When the price falls in the lower tail of the price distribution, a repurchase firm, like a lead-manager in the IPO aftermarket, engages in repurchasing its shares, thereby supporting its price and reducing its price volatility.

It is only recently that we started learning about market-stabilization activity in the IPO market. Like the IPO market, we still do not know details of how open market share repurchase firms implement buyback programs, mainly because of the absence of reporting requirements. Deeper understanding of buyback trading activity of open market share repurchase firms can provide further insights on market-making activity in the equity issuance aftermarket. Or conversely, future research on IPO aftermarket support activity can increase understanding of buyback trading activity by an open market share repurchase firm.

Appendix
SEC Rule 10b - 18: Overview

Before SEC Rule 10b-18 was adopted in 1982, open market share repurchases involved significant uncertainties regarding potential liability under the anti-manipulation provisions of the Securities Exchange Act of 1934. Without explicit rules or direct guidelines, an open market share repurchase firm faced a possibility of being charged with illegal price manipulation. Grullon and Michaely (2002) document evidence consistent with the hypothesis that this widespread fear deterred firms from actively engaging in open market buybacks despite their tax advantage relative to dividends before the 1982 enactment of Rule 10b-18.

From the 1960's, several rules including SEC Rule 10b-10 and Rule 13e-2 were proposed to regulate open market repurchases. Each of these rules, if it had been adopted, "would have been a proscriptive rule with disclosure requirements, purchasing limitations and general anti-fraud liability," quoted from Supplementary Information provided for the 1999 amendment to Rule 10b-18.

Instead, in the middle of the deregulation wave of Reagan administration in the early eighties, the SEC adopted Rule 10b-18 that gave safe harbor to open market share repurchase firms. Thanks to this Rule, compliance with the Rule's conditions is voluntary and disclosure of the repurchase activity is not mandatory. This is in stark contrast to relatively stringent reporting and disclosure requirements that usually accompany other corporate events including tender offer repurchases and insider trading activities. According to Grullon and Michaely (2002), this Rule is a major factor behind the recent upsurge in open market share repurchases in the United States.

Kim, Schremper, Varaiya (2003) examine open market repurchase regulations of the ten largest stock markets around the world, and find that the United States is the most lenient country in terms of regulating open market share repurchases. Kim and Varaiya (2003), focusing on the U.S. open market share repurchase regulations, further argue that the loose disclosure requirements in the U.S. can create room for conflicts of interests between insider shareholders and outside shareholders. At the same time a firm is buying back its own shares, the firm's insiders can be selling their holdings of the firm's stock. But, at any given point of time, whether a firm is repurchasing shares or not is unknown to outside investors, due to the lack of disclosure. In Austria, France, Germany, Japan, Korea, the Netherlands, and Norway, it is only in recent years when open market repurchases became possible, as law reforms legalized the repurchase or simplified procedures or tax provisions. Although the

worldwide trend is toward deregulation of open market share repurchases (Brewis (1998), Grullon and Ikenberry (2000), and Grullon and Michaely (2002)), in many countries, open market share repurchase is relatively strictly regulated in terms of disclosure and implementation.

For the history of repurchase regulation in the U.S., Cook, Krigman, and Leach (2002) provide an excellent review. Cook et al. contend that conformity to Rule 10b-18 is essentially unverifiable, and they present evidence that repurchase firms do not comply with the conditions set forth by the rule.

It is noteworthy that even if a repurchase firm does not abide by the provisions, this alone does not make the firm's action illegal or in violation of anti-price manipulation laws. By not conforming to the provisions of Rule 10b-18, the firm no longer has the safe harbor protection or immunity. However, the firm is not subject to legal liability, solely based on this non-compliance. The paragraph (d) (the last paragraph of Rule 10-18) states this.

As aforementioned, SEC Rule 10b-18 gives repurchasing firms immunity from anti-manipulative provisions under Sections 9(a)(2) and 10(b) and Rule 10b-5 of the Securities Exchange Act of 1934, provided that certain conditions are satisfied.[30] The four conditions are listed below. For each condition, I included the direct excerpts from Supplementary Information provided for the 1999 amendment to Rule 10b-18. The Supplementary Information lists regulatory intents for each of the four conditions provided by the rule.

(Manner of purchase) Repurchases are made through only one broker or dealer in a given day.

"The *manner of purchase* condition requires an issuer to use a single broker or dealer on any given day to bid for or purchase its common stock. This provision deters an issuer from creating the appearance of widespread broker-dealer interest and trading activity in its security."

(Timing condition) No repurchase is made as an opening transaction or during the last half hour of trading in a given day.

[30] Rule 10b-5 has comprehensive provisions against fraud and price manipulation related to the purchase or sale of any security, and has been interpreted broadly by the courts.

"The *timing condition* specifies that an issuer's purchase may not be the opening transaction reported to the consolidated transaction reporting system nor may purchases be made during the last half-hour before the scheduled close of trading. Because they tend to forecast the direction of trading and suggest the strength of demand, purchases effected at the opening or close of trading are generally considered to be significant indicators of the current market value of the security. Therefore the safe harbor does not cover opening bids and purchases and bids and purchases near or at the close of trading by the issuer."

(*Price condition)* No repurchase is made at a price exceeding the highest current independent bid price or the last independent sale price, whichever is higher.

"The *price condition* specifies the highest price an issuer may bid or pay for its common stock. Because the price condition generally limits the issuer to bidding for or buying its security at a price that is no higher than the current independent published bid or last independent transaction price, it ensures that the issuer would not lead the market for its security through its repurchases."

(Volume condition) Non-block repurchase volume does not exceed the higher of (A) one round lot or (B) the number of round lots closest to 25% of the average daily trading volume for the preceding four calendar weeks.

"The *volume condition* is designed to prevent an issuer from dominating the market for its securities through substantial purchasing activity. Generally, the issuer may effect daily purchases, excluding block purchases, in an amount up to 25 % of the trading volume in its shares. Although excepted from the volume condition, all other Rule 10b-18 conditions apply to block purchases."[31]

[31] Block is defined as a quantity of stock that either: (i) has a purchase price of $ 200,000 or more; or (ii) is at least 5,000 shares and has a purchase price of at least $ 50,000; or (iii) is at least 20 round lots of the security and totals 150 % or more of the trading volume for that security or, in the event that trading volume data are unavailable, is at least 20 round lots of the security and totals at least one-tenth of one % (0.001) of the outstanding shares of the security, exclusive of any shares owned by any affiliate. Block does not include any amount a broker or dealer, acting as principal, has accumulated for the purpose of selling

to the issuer or affiliated purchaser, if the issuer or affiliated purchaser knows or has reason to know that such amount was accumulated for such purpose, nor does it include any amount that a broker or dealer has sold short to the issuer, if the issuer or affiliated purchaser knows or has reason to know that the sale was a short sale. [17 CFR 240.10b-18(a)(14)]

References

Allen, F., Michaely, R., 2002. Payout policy. In: Constantinides, G., Harris, M., Stultz, R. (Eds.), North-Holland Handbooks of Economics, forthcoming.

Aggarwal, R., 2000. Stabilization activities by underwriters after initial public offerings. Journal of Finance 55, 1075-1104.

Barth, M., and Kasznik, R., 1999. Share repurchases and intangible assets. Journal of Accounting and Economics 28, 211-241.

Bartov, E., 1991. Open-market stock repurchases as signals for earnings and risk changes. Journal of Accounting and Economics 14, 275-294.

Brennan, M., Thakor, A., 1990. Shareholder preferences and dividend policy. Journal of Finance 45, 993-1018.

Brewis, J., 1998. Euro corporates push for share repurchase rights. Corporate Finance 164 (July issue), 30-34.

Brockman, P., Chung, D., 2001. Managerial timing and corporate liability: evidence from actual share repurchases. Journal Financial Economics 61, 417-448.

Campbell, J., Lettau, M., Malkiel, B., Xu, Y., 2001. Have individual stocks become more volatile? An empirical exploration of idiosyncratic risk. Journal of Finance 56, 1-43.

Chan K., Ikenberry, D., Lee, L., 2001. Do firms knowingly repurchase stock for good reason? Unpublished working paper. Rice University.

Comment, R., Jarrell, G., 1991. The relative signaling power of Dutch-auction and fixed-price self-tender offers and open market share repurchases. Journal of Finance 46, 1243-1271.

Cook, D., Krigman, L., Leach, C., 2000. On the timing and execution of open market repurchases. Unpublished working paper. University of Arizona.

Cook, D., Krigman, L., Leach, C., 2002. An analysis of SEC guidelines for executing open market repurchases. Journal of Business, forthcoming.

Copeland, T., Galai, D., 1983. Information effects on the bid-ask spread. Journal of Finance 38, 1457-1469.

Dann, L., 1981. Common stock repurchases. an analysis of returns to bondholders and stockholders. Journal of Financial Economics 9, 113-138.

Dann, L., Masulis, R., Mayers, D., 1991. Repurchase tender offers and earnings information. Journal of Accounting Information 14, 217-251.

Denis, D., Kadlec, G., 1994. Corporate events, trading activity, and the estimation of systematic risk: evidence from equity offerings and share repurchases. Journal of Finance 40, 1787-1811.

Dittmar, A., 2000. Why do firms repurchase stock? Journal of Business 73, 331-355.

Ellis, K., Michaely, R., O'Hara, M., 2000. When the underwriter is the market maker: an examination of trading in the IPO aftermarket. Journal of Finance 55, 1039-1074.

Fama, E., French, K., 2001. Disappearing dividends: Changing firms characteristics or lower propensity to pay? Journal of Financial Economics 60, 3-43.

Fenn, G., Liang, N., 2001. Corporate payout policy and managerial stock incentives. Journal of Financial Economics 60, 45-72.

Franz, D., Rao, R., Tripathy, N., 1995. Informed trading risk and bid-ask spread changes around open market stock repurchases in the NASDAQ market. Journal of Financial Research 18, 311-327.

Grullon, G., Ikenberry, D., 2000. What do we know about stock repurchases? Journal of Applied Corporate Finance 13, 31-51.

Grullon, G., Michaely, R., 2002. Dividends, share repurchases, and the substitution hypothesis. Journal of Finance, forthcoming.

Grullon, G., Michaely, R., Swaminathan, B., 2001. Are dividend changes a sign of firm maturity? Journal of Business, forthcoming.

Guay, W., Harford, J., 2000. The cash-flow permanence and information content of dividend increases versus repurchases. Journal of Financial Economics 57, 385-415.

Hatakeda, T., Isagawa, N., 2001. Stock price behavior surrounding repurchase announcements: evidence from Japan. Unpublished working paper. Kobe University (Japan).

Hausch, D., Seward, J., 1993. Signaling with dividends and share repurchases: a choice between deterministic and stochastic cash disbursement. Review of Financial Studies 1993, 121-154.

Hertzel, M., Jain, P., 1991. Earnings and risk changes around stock repurchase tender offers. Journal of Accounting and Economics 14, 253-274.

Ho, L., Liu, C., Ramanan, R., 1997. Open-market stock repurchase announcements and revaluation of prior accounting information. Accounting Review 72, 475-487.

Huang, R., Stoll, H., 1996. Dealer versus auction markets: a paired comparison of execution costs on NASDAQ and the NYSE. Journal of Financial Economics 41, 313-357.

Hull, J., 1998. Introduction to futures and options markets, Prentice Hall, New Jersey.

Ikenberry, D., Vermaelen, T., 1996. The option to repurchase stock. Financial Management 25, 9-24.

Ikenberry, D., Lakonishok, J., Vermaelen, T., 1995. Market underreaction to open market share repurchases. Journal of Financial Economics 39, 181-208.

Ikenberry, D., Lakonishok, J., Vermaelen, T., 2000. Open market stock repurchase: the Canadian experience. Journal of Finance 55, 2373-2397.

Isagawa, N., 2000. Open market stock repurchases in a limited arbitrage-noise trader model. Unpublished working paper. Kobe University (Japan).

Isagawa, N., 2001. Open market stock repurchases and stock price behavior when management values real investment. Financial Review, forthcoming.

Jagannathan, M., Stephens, C., Weisbach, M., 2000. Financial flexibility and the choice between dividends and stock repurchases. Journal of Financial Economics 57, 355-384.

Jensen, M., 1986. Agency cost of free cash flow. American Economic Review 76, 323-329.

Kamara, A., Koski, J., 2001. Volatility, autocorrelations, and trading activity after stock splits. Journal of Financial Markets 4, 163-184.

Karpoff, J., 1987. The relation between price changes and trading volume: a survey. Journal of Financial and Quantitative Analysis 22, 109-126.

Kahle, K., 2002. When a buyback isn't a buyback: open market repurchases and employee options. Journal of Financial Economics, forthcoming.

Kim, J., 2003. Cross sectional differences in liquidity effects of open market share repurchases. Unpublished working paper. San Diego State University.

Kim, J., Varaiya, N., 2003, Open Market Share Repurchase Regulation in the U.S.: Do they create a conflict of interest? Unpublished working paper. San Diego State University.

Kim, J., Schremper, R., Varaiya, N., 2003, Survey on Open Market Share Repurchase Regulations: Cross-country examination of the ten largest stock markets. Unpublished working paper. San Diego State University.

Koski, J., 1998. Measurement effects and the variance of returns after stock splits and stock dividends. Review of Financial Studies 11, 143-162.

Lakonishok, J., Vermaelen, T., 1990. Anomalous price behavior around repurchase tender offers. Journal of Finance 45, 455-477.

Lie, E., 2000. Excess funds and agency problems: an experimental study of incremental cash disbursements. Review of Financial Studies 13, 219-248.

Lucas, D., McDonald, R., 1998. Shareholder heterogeneity, adverse selection, and payout policy. Journal of Financial and Quantitative Analysis 33, 233-253.

Masulis, R., 1980. Stock repurchase by tender offer: an analysis of the causes of common stock price changes. Journal of Finance 35, 305-319.

Ofer, A., Thakor, A., 1987. A theory of stock price responses to alternative corporate cash disbursement methods: stock repurchases and dividends. Journal of Finance 42, 365-394.

Rice, E., 1999. What stock price changes mean when events affect shareholders differently. Unpublished working paper. University of Washington.

Schwartz, R., 1993. Reshaping the equity markets: a guide for the 1990s. Business One Irwin, Illinois.

Stephens, C., Weisbach, M., 1998. Actual share reacquisitions in open-market repurchase programs. Journal of Finance 53, 313-333.

Vermaelen, T., 1981. Common stock repurchases and market signaling: an empirical study. Journal of Financial Economics 9, 139-183.

Weisbenner, S., 2000. Corporate share repurchases in the 1990's: what role do stock options play? Unpublished working paper. Federal Reserve Board.

Table 1
Sample Descriptive Statistics
Open Market Share Repurchase Announcements

This table provides descriptive statistics for the open market share repurchase announcement sample acquired from the Thomson Financial Securities Data for the period of 1990 - 1992. The table shows yearly and by-market tabulation of the announcements, in which NYSE/AMEX stands for the New York Stock Exchange/the American Stock Exchange, and NASDAQ stands for the NASDAQ stock market. The sample of size 978 in Panel A is used in an analysis based on the ISSM data (Institute for the Study of Security Markets). The expanded sample of size 1,385 in Panel B is used in an analysis based on CRSP daily returns.

Panel A			
Year	NYSE/AMEX	NASDAQ	
1990	299	250	549
1991	138	93	231
1992	198	0	198
Total	635	343	978

Panel B (Expanded Sample)			
Year	NYSE/AMEX	NASDAQ	
1990	307	360	667
1991	143	138	281
1992	201	236	437
Total	651	734	1385

Table 2
Univariate Analyses

Paired t-tests (1), Wilcoxon Signed-Ranks Tests (2), and sign tests (3) are preformed on changes in daily return standard deviations. Diff is equal to (the post-announcement mean/median minus the pre-announcement mean/median), and number(>0) is the number of observations with positive sign changes from the pre-announcement level to the post-announcement level. Daily return standard deviations are measured using the midpoints of daily closing bid-ask spreads for +60 and –60 trading days, respectively, relative to day 0 (the announcement day). NYSE/AMEX and NASDAQ stand for the New York Stock Exchange/the American Stock Exchange and the NASDAQ market, respectively. The significance levels are determined based on a one tailed test, in which * denotes 10 %, ** 5 %, and *** 1 %. T-stat/z-score indicates t-statistics and z-scores corresponding to each of the three tests. N represents the number of observations.

Daily Return Std. Dev.					
	mean(pre)	mean(post)	(1) mean diff	(2) median diff	(3) number(>0)
Panel A: Entire Sample					
	0.0271	0.0252	***-0.0019	***-0.0017	***399
t-stat/z-score			-3.35	-6.61	-5.54
N			978	978	978
Panel B: NYSE/AMEX					
	0.0229	0.0214	***-0.0015	***-0.0013	***264
t-stat/z-score			-3.52	-5.06	-3.99
N			635	635	635
Panel C: NASDAQ					
	0.0349	0.0322	**-0.0026	***-0.0036	***135
t-stat/z-score			-1.88	-4.21	-3.89
N			343	343	343

Table 3
Control Sample Analysis

A control sample is constructed based on matching criteria that include (i) the market (NYSE/AMEX or NASDAQ), (ii) daily return standard deviations, (iii) percentage bid-ask spreads, and (iv) price levels. The paired t-tests are provided for the repurchase sample and the control sample: diff(a) and diff(b) are equal to (the post-announcement mean minus the pre-announcement mean) for the repurchase sample and the control sample, respectively. The column (1) is for the unpaired t-test between the repurchase sample and the control sample, and the column (2) is for the unpaired Wilcoxon rank sum test between the repurchase sample and the control sample. Daily return standard deviations are measured using the midpoints of daily closing bid-ask spreads for +60 and –60 trading days, respectively, relative to day 0 (the announcement day). The statistical significance is based on a one-tailed test in which * denotes significance at 10 %, ** denotes significance at 5 %, and *** denotes significance at 1 %. T-stat/z-score indicates t-statistics and z-scores corresponding to each of the two tests. N represents the number of observations.

Change in Daily Return Volatility								
	Repurchase Sample			Control Sample			(1)	(2)
	pre	post	diff(a)	pre	post	diff(b)	mean diff (a) - (b)	median diff (a) - (b)
	0.0271	0.0252	***-0.0019	0.0271	0.0288	**0.0017	***-0.0036	***-0.0010
t-stat/z-score			-3.35			2.30	-3.86	-4.47
n			978			978		

Table 4
Test Results for the *Buyback Trading Hypothesis*

The mean differences (diff = post-announcement minus pre-announcement) and the paired t-test statistics (t-stat) are provided for changes in daily return standard deviations. Daily return standard deviations are measured using the midpoints of daily closing bid-ask spreads for +60 and –60 trading days, respectively, relative to day 0 (the announcement day). INTENS1 is the subgroup in which the estimated buyback trading intensity (number of shares repurchased divided by average daily trading volume) is the weakest, and INTENS3 is the subgroup in which the estimated buyback trading intensity is the strongest. N stands for the number of observations. The significance levels are determined based on a one tailed test, in which * denotes 10 %, ** 5 %, and *** 1 %. N represents the number of observations.

	Daily Return Std. Dev.		
	pre	**post**	**diff**
Panel A: Entire Sample			
	0.0271	0.0252	***-0.0019
t-stat			-3.35
N			978
Panel B: INTENS1 – INTENS3 (actual buyback trading intensity)			
(low) INTENS1	0.0276	0.0266	-0.0010
t-stat			-1.00
n			220
INTENS2	0.0277	0.0253	***-0.0024
			-2.36
			220
(high) INTENS3	0.0234	0.0208	***-0.0026
			-3.27
			220

Table 5
Test Results for the *Reduced Growth Option Hypothesis*

Three measures are calculated from Compustat: (1) CAPEXP: Capital Expenditure / Total Assets, (2) STDINC: standard deviation of Operating Incomes, and (3) MKTBK: market value of equity / book value of equity. The market value of equity is computed by multiplying the fiscal year end price by the fiscal year end number of shares outstanding. Relative to year 0 (announcement year), years –2 to –1 and years +1 to +2 are examined. For CAPEXP and MKTBK, Compustat Annual Data Files are used, and for STDINC, Compustat Quarterly Data Files are used to calculate standard deviations. The control sample is the volatility-matched control sample constructed from the ISSM tapes based on (1) NYSE/AMEX or NASDAQ, (2) (pre-announcement) daily return standard deviations, (3) (per-announcement) average percentage spreads, and (4) (per-announcement) average price levels. Pre stands for a mean value for the pre-announcement period, and post the post announcement period. Diff is (the post-announcement mean minus the pre-announcement mean), and n stands for a number of observations. T-statistics (t-stat) are provided for mean difference tests. The significance levels are determined based on a one tailed test, in which * denotes 10 %, ** 5 %, and *** 1 %.

	REPURCHASE SAMPLE			CONTROL SAMPLE			
	CAPEXP						
	pre	**post**	**diff(1)**	**pre**	**post**	**diff(2)**	**(1) minus (2)**
	0.0567	0.0507	***-0.0060	0.0724	0.0641	***-0.0083	0.0022
t-stat			-3.23			-3.13	0.69
n			441			441	
	STDINC						
	pre	**post**	**diff(1)**	**pre**	**post**	**diff(2)**	**(1) minus (2)**
	0.0118	0.0137	***0.0019	0.0135	0.0148	0.0012	0.0006
t-stat			2.83			0.83	0.39
n			306			306	
	MKTBK						
	pre	**post**	**diff(1)**	**pre**	**post**	**diff(2)**	**(1) minus (2)**
	1.8861	2.1034	*0.2173	2.9758	3.5012	0.5254	-0.3081
t-stat			1.58			0.69	-0.40
n			514			514	

Table 6
Multiple Regression (Dependent Variable: ΔVOLAT)

ΔVOLAT is regressed on ΔVOLUME, ΔMKTVOLAT, Δ%SPREAD, VOLAT, EXCH, and INTENS. Δ denotes (the post-announcement figure minus the pre-announcement figure), and the list of the independent variables is provided below. For VOLAT, therefore ΔVOLAT, the standard deviations of daily returns for 60 trading days before and after the announcements, respectively, are used. Daily returns are measured by using daily closing bid-ask midpoints and they are averaged across 60 trading days before and after the announcements, respectively. To calculate ΔMKTVOLAT (market volatility), the standard deviations of the returns of CRSP dividend adjusted value weighted index are used for the pre-announcement and the post-announcement 60 trading days. Total number of shares traded per day is the daily trading volume. These daily figures are averaged across 60 trading days before and after the announcements, respectively, to come up with VOLUME (the unit: 1000 shares). Δ%SPREAD is the difference between -60 day average percentage spreads and +60 day average percentage spreads. INTENS is a proxy for actual buyback trading intensity (number of shares repurchased divided by average daily trading volume). The White heteroskedasticity-consistent standard errors are used and the corresponding p-values are based on two-tailed tests. R^2 = R-squared. N = number of observation. * : significant at 10 %. **: significant at 5%. ***: significant at 1%.

	coefficients	t-stat	p-value
Intercept	***0.008236	7.62	0.0000
ΔVOLUME	***0.000043	3.81	0.0002
ΔMKTVOLAT	**0.517332	2.04	0.0415
Δ%SPREAD	***0.311373	3.42	0.0007
VOLAT	***-0.400974	-8.39	0.0000
EXCH	0.001893	1.18	0.2380
INTENS	***-0.000067	-2.79	0.0054
R^2	0.3995		
N	660		

Independent Variable List	
ΔVOLUME	post-ann't average - pre-ann't average (daily number of shares traded; unit 1000 shares)
ΔMKTVOLAT	post-ann't - pre-ann't (standard deviation of CRSP value weighted index returns)
Δ%SPREAD	post-ann't average - pre-ann't average (average daily percentage spread)
VOLAT	pre-ann't standard deviation of daily returns
EXCH	= 1 if NASDAQ. = 0 if NYSE/AMEX.
INTENS	estimates for actual buyback trading intensity

Table 7
Buyback Trading Activity and Price Level

The midpoints of daily closing bid-ask spreads are used to calculate price levels. For Panel A and Panel B, the average price levels for -60 trading days relative to day 0 (the announcement day) are compared to the average price levels for +60 trading days. INTENS is a proxy for actual buyback trading intensity, and the buyback intensity is measured by dividing the estimated number of shares repurchased by average daily trading volume. INTENS1 is a group in which buyback trading intensity is the lowest, and INTENS3 is a group in which buyback trading intensity is the highest. The significance levels are determined based on a one tailed test, in which * denotes 10 %, ** 5 %, and *** 1 %.

	Price Level		
	pre	**post**	**diff**
Panel A: Entire Sample			
	21.44	21.22	**-0.22
t-stat			-1.72
n			978
Panel B: INTENS 1 - INTENS 3			
(low) INTENS1	19.19	19.12	-0.07
t-stat			-0.27
n			220
INTENS2	29.12	28.91	-0.22
			-0.54
			220
(high) INTENS3	22.73	22.22	**-0.51
			-2.11
			220

Table 7 (continued)
Buybback Trading Activity and Price Level

In Panel C and Panel D, relations between price changes (ΔPRICE) and buyback trading intensity (INTENS) are examined. $\Delta PRICE_{Dj} = \left(\frac{p_{Dj} - p_{-1j}}{p_{-1j}} \right)$, in which D stands for day D relative to day 0 (the announcement day). Panel C shows the correlation coefficients between ΔPRICE and INTENS for D = 30, D = 40, and D = 50. Panel D shows the averages of ΔPRICE for D = 30, D = 40, and D = 60 for each of INTENS1 – INTENS3. INTENS (raw number) is a proxy for actual buyback trading intensity, and buyback trading intensity is measured by dividing the estimated number of shares repurchased by average daily trading volume. The INTENS (category) indicates a category variable, in which I assign 1, 2, and 3 for INTENS1, INTENS2, and INTENS3, respectively. N stands for a number of observations.

Panel C: Correlation Coefficients

	D = 30	D = 40	D = 50
	ΔPRICE	**ΔPRICE**	**ΔPRICE**
INTENS (raw number)	-0.1150	-0.1452	-0.1575
p-value	0.0058	0.0005	0.0002
N	575	568	563
INTENS (category)	-0.1646	-0.2010	-0.2218
p-value	0.0001	0.0001	0.0001
N	575	568	563

Panel D: Average ΔPRICE

	D = 30	D = 40	D = 50
INTENS1 (low)	0.0768	0.0935	0.1177
INTENS2	0.0313	0.0521	0.0715
INTENS3 (high)	0.0170	0.0128	0.0136

Table 8
Buyback Trading Hypothesis and CRSP Return Volatility

The mean differences (diff = post-announcement minus pre-announcement) and the paired t-test statistics (t-stat) are provided for daily return standard deviations. CRSP daily returns are used to compute daily return standard deviations for +60 and –60 trading days, respectively, relative to day 0 (the announcement day). INTENS1 is the subgroup in which estimated buyback trading intensity (number of shares repurchased divided by daily average trading volume) is the weakest, and INTENS3 is the subgroup in which estimated buyback trading intensity is the strongest. N stands for the number of observations. The significance levels are determined based on a one tailed test, in which * denotes 10 %, ** 5 %, and *** 1 %. N represents the number of observations.

	Daily Return Std. Dev.		
	pre	post	diff
Panel A: Entire Sample			
	0.0311	0.0304	**-0.0007
t-stat			-1.95
N			1385
Panel B: INTENS1 – INTENS3 (actual buyback trading intensity)			
(low) INTENS1	0.0343	0.0339	-0.0004
t-stat			-0.49
n			308
INTENS2	0.0301	0.0297	-0.0004
			-0.65
			308
(high) INTENS3	0.0292	0.0279	***-0.0013
			-2.35
			308

Table 9
Univariate Analyses: Longer Term

$\Delta VOLAT_T$ is the difference between the daily return standard deviation of the quarter and the standard deviation of the immediately preceding quarter: $\Delta VOLAT_T = VOLAT_T - VOLAT_{T-1}$ (T=1,2,3,4). $VOLAT_0$ is daily return standard deviation of the announcement quarter. $\Delta INTENS_T$ is the difference between the buyback trading intensity of the quarter and the buyback trading intensity of the immediately preceding quarter: $\Delta INTENS_T = INTENS_T - INTENS_{T-1}$ (T=1,2,3,4). $INTENS_0$ is buyback trading intensity of the announcement quarter, and $INTENS_0$ is assumed to be zero. INTENS, the estimate for buyback trading intensity, is computed by dividing the estimated number of shares repurchased by CRSP average daily trading volume. The number of shares repurchased is estimated from 'Purchases of Common and Preferred Stock' for four fiscal quarters, respectively, following the announcement quarter. The standard deviation ($VOLAT_T$) for each corresponding quarter is computed from the CRSP daily returns. Quintile 1 – Quintile 5 are the quintiles, in which Quintile 1 has the smallest values of ΔINTENS and Quintile 5 has the largest values of ΔINTENS. The significance levels are determined based on a one tailed test, in which * denotes 10 %, ** 5 %, and *** 1 %. N represents the number of observations.

	Daily Return Std. Dev.		
	$VOLAT_{T-1}$	$VOLAT_T$	$\Delta VOLAT_T$
Panel A: Entire Sample			
	0.0305	0.0299	***-0.0005
t-stat			-3.38
N			5026
Panel B: Quintile 1 – Quintile 5 (ΔINTENS)			
(low) Quintile 1	0.0296	0.0307	***0.0011
t-stat			2.92
N			758
Quintile 2	0.0302	0.0297	-0.0005
			-0.99
			395
Quintile 3	0.0343	0.0328	***-0.0014
			-4.49
			1228
Quintile 4	0.0284	0.0285	0.0001
			0.15
			654
(high) Quintile 5	0.0301	0.0288	***-0.0013
			-3.44
			758

Table 10
Multiple Regression: Longer Term
(Dependent Variable: $\Delta VOLAT_T = VOLAT_T - VOLAT_{T-1}$)

$\Delta VOLAT_T$ is regressed on a constant term, $\Delta INTENS_T$, $\Delta VOLUME_T$, and $VOLAT_{T-1}$. $\Delta VOLAT_T$ is the difference between the daily return standard deviation of the quarter and the standard deviation of the immediately preceding quarter: $\Delta VOLAT_T = VOLAT_T - VOLAT_{T-1}$ (T=1,2,3,4). $VOLAT_0$ is daily return standard deviation of the announcement quarter. $\Delta INTENS_T$ is the difference between the buyback trading intensity of the quarter and the buyback trading intensity of the immediately preceding quarter: $\Delta INTENS_T = INTENS_T - INTENS_{T-1}$ (T=1,2,3,4). $INTENS_0$ is buyback trading intensity of the announcement quarter, and $INTENS_0$ is assumed to be zero. INTENS, the estimate for buyback trading intensity, is computed by dividing the estimated number of shares repurchased by CRSP average daily trading volume. The number of shares repurchased is estimated from 'Purchases of Common and Preferred Stock' for four fiscal quarters, respectively, following the announcement quarter. The standard deviation, $VOLAT_T$, for each corresponding quarter is computed from the CRSP daily returns. The average number of shares traded per day is the daily trading volume. $VOLUME_T$ is the quarterly average of these daily figures for each fiscal quarter. $\Delta VOLUME_T = VOLUME_T - VOLUME_{T-1}$ (T=1,2,3,4), and the unit is 1000 shares. $VOLUME_0$ is the average daily trading volume of the announcement quarter. The White heteroskedasticity-consistent standard errors are used, and the corresponding p-values are based on two-tailed tests. R^2 = R-squared. N = number of observation. * : significant at 10 %. **: significant at 5%. ***: significant at 1%.

Dependent Variable: $\Delta VOLAT_T$ (= $VOLAT_T - VOLAT_{T-1}$)			
	coefficients	**t-stat**	**p-value**
Intercept	***0.004671	9.67	0.0000
$\Delta INTENS_T$	**-0.000013	-2.26	0.0242
$\Delta VOLUME_T$	***0.000018	9.51	0.0000
$VOLAT_{T-1}$	***-0.168009	-9.23	0.0000
R^2	0.1133		
N	3793		

Table 11
CAPM Beta

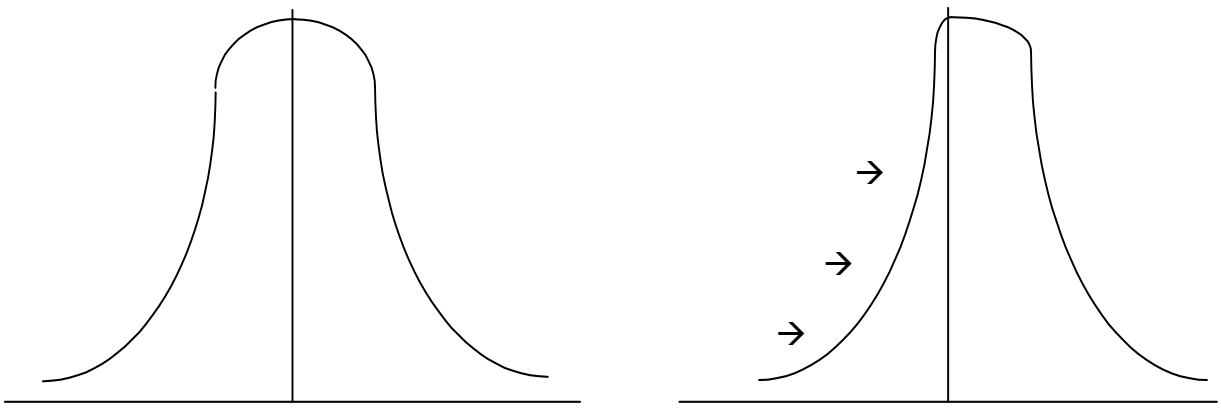
Paired t-tests (1), Wilcoxon Signed-Ranks Tests (2), and sign tests (3) are preformed on changes in CAPM beta. Diff is equal to (the post-announcement mean/median minus the pre-announcement mean/median), and number(>0) is the number of observations with positive sign changes from the pre-announcement level to the post-announcement level. CAPM beta's are measured by regressing CRSP daily returns on a constant term and CRSP value weighted indexes (distribution-included) for one calendar year before and after the announcements, respectively. The post-announcement one year period starts on the first day of the fiscal quarter that immediately follows the announcement fiscal quarter, and the pre-announcement one year period ends on the last day of the fiscal quarter that immediately precedes the announcement fiscal quarter. Panel A is for 169 announcements with no actual share buyback for the post-announcement one year period, and Panel B is for 169 announcements with the highest buyback trading intensity (INTENS) as measured by the number of shares repurchased divided by CRSP average daily trading volume. The number of shares repurchased is estimated from 'Purchases of Common and Preferred Stock' from Compustat. The significance levels are determined based on a one tailed test, in which * denotes 10 %, ** 5 %, and *** 1 %. T-stat/z-score indicates t-statistics and z-scores corresponding to each of the three tests. N represents the number of observations.

CAPM beta					
	mean(pre)	mean(post)	(1) mean diff	(2) median diff	(3) number(>0)
Panel A (No buyback)					
	0.8068	0.8261	0.0193	0.0577	90
t-stat/z-score			0.44	0.59	0.80
N			169	169	169
Panel B (Intense buyback)					
	0.5336	0.4599	**-0.0737	**-0.0617	*74
t-stat/z-score			-2.23	-2.15	-1.54
N			169	169	169

Table 12
Multiple Regression: CAPM beta
(Dependent Variable: ΔBETA = $BETA_{POST}$ – $BETA_{PRE}$)

CAPM beta's ($BETA_{PRE}$, $BETA_{POST}$) are measured by regressing CRSP daily returns on a constant term and CRSP value weighted indexes (distribution-included) for the periods of pre-announcement one calendar year and post-announcement one calendar year, respectively. The post-announcement one year period starts on the first day of the fiscal quarter that immediately follows the announcement fiscal quarter, and the pre-announcement one year period ends on the last day of the fiscal quarter that immediately precedes the announcement fiscal quarter. In Panel A, ΔBETA (=$BETA_{POST}$ – $BETA_{PRE}$) is regressed on $BETA_{PRE}$ and INTENS_DUM. INTENS_DUM is a dummy variable equal to zero if an observation belongs to a group of 169 announcements with no actual share buybacks for the post-announcement one year period, and equal to one if an observation belongs to a group of 169 announcements with the highest buyback trading intensity for the post-announcement one year period. In Panel B, ΔBETA (=$BETA_{POST}$ – $BETA_{PRE}$) is regressed on $BETA_{PRE}$ and INTENS_YR. INTENS_YR is a raw estimate for buyback trading intensity for the post-announcement one year period, and is computed by dividing the estimated number of shares repurchased by CRSP average daily trading volume. The number of shares repurchased is estimated from 'Purchases of Common and Preferred Stock' from Compustat. The White heteroskedasticity-consistent standard errors are used, and the corresponding p-values are based on two-tailed tests. R^2 = R-squared. N = number of observation. * : significant at 10 %. **: significant at 5%. ***: significant at 1%.

	coefficients	t-stat	p-value
	Panel A		
Intercept	***0.4224	6.79	0.0000
$BETA_{PRE}$	***-0.4996	-8.15	0.0000
INTENS_DUM	***-0.2295	-4.51	0.0000
R^2	0.2556		
N	338		
	Panel B		
Intercept	***0.3269	10.15	0.0000
$BETA_{PRE}$	***-0.4361	-12.50	0.0000
INTENS_YR	**-0.0010	-2.27	0.0237
R^2	0.2415		
N	959		



Price Distribution (No buyback)

Price Distribution (When a firm buys back)

Fig. 1. Buyback Trading and Price Distribution (*Buyback Trading Hypothesis*): The first graph on the left represents a hypothetical, bell-shaped price distribution that will realize if the firm does not buy back. The second is a hypothetical, bell-shaped price distribution that will realize if the firm buys back shares when the share price falls in the lower tail of the distribution. The vertical line stands for the mean value of the distribution. The arrows on the second graph show the price increase effect resulting from buyback trading.

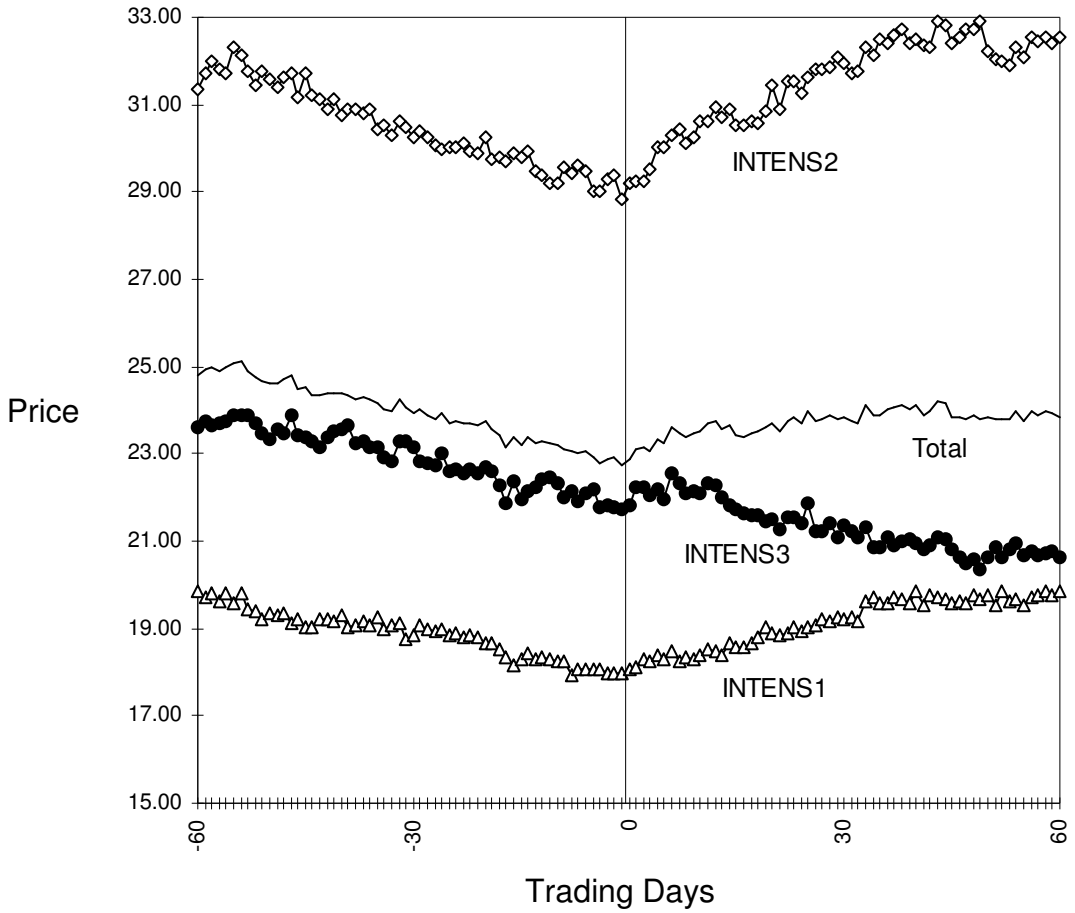


Fig. 2. Buyback Trading and Price Level: Figure 2 plots changes in average price levels across 121 trading days around the announcement day (day 0). Average price levels are measured by taking the average of all daily closing bid-ask midpoints for the entire sample (Total), for INTENS1, for INTENS2, and for INTENS3, respectively. Buyback trading intensity (INTENS) is defined as the estimated number of shares repurchased divided by average daily trading volume. INTENS1, INTENS2, and INTENS3 are subgroups, in which INTENS1 is the subgroup with the lowest buyback trading intensity, and INTENS3 the highest buyback trading intensity.