DO FIRMS BUY THEIR STOCK AT BARGAIN PRICES? EVIDENCE FROM ACTUAL STOCK REPURCHASE DISCLOSURES

by

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Abstract

We use new data from SEC filings to investigate how S&P 500 firms execute their open-market repurchase programs. We find that smaller S&P 500 firms repurchase less frequently than larger firms, and at a price which is significantly lower than the average market price. Their repurchase activity is followed by a positive and significant abnormal return which lasts up to three months after the repurchase. These findings do not hold for large S&P 500 firms. Our interpretation is that small firms repurchase strategically, whereas the repurchase activity of large firms is more focused on the disbursement of free cash. Consistent with this interpretation, we show that the market response to the disclosure of actual repurchase data is positive and significant only for small firms, and that insider trading is positively related to actual repurchases.

Keywords: Stock Repurchases; Stock Buybacks; Payout Policy; Timing; Bid-Ask Spread; Liquidity; Insider Trading.

JEL classification: G14; G30; G35

The question whether firms time their repurchases is important as such timing may result in wealth transfers among investors if they are not fairly priced. Indeed, Brav, Graham, Harvey, and Michaely (2005) survey corporate executives and find they view buybacks as being more flexible than dividends and use this flexibility to time the market by accelerating repurchases when they believe their stock price is low. Earlier investigations of repurchase timing have focused on repurchase program announcements (e.g. Ikenberry, Lakonishock, and Vermaelen 1995 and more recently Peyer and Vermaelen 2009). However, the timing of program announcements can be very different than the timing of actual repurchases. In fact, it may take the firm several years to complete a program, if it completes the program at all (see Stephen and Weisbach 1998).

While stock repurchases have become an economically significant payout tool in the US, little is known about the timing of actual repurchases.[1] This is because in the past, firms were required to report only the aggregate number of shares repurchased over the quarter, without distinguishing between market and non-market transactions. Firms were also not required to report any information about the prices of their repurchase trades.[2] However, following amendments to SEC Rule 10b-18, as of the beginning of 2004, US firms are required to report detailed information about their repurchase activity in their quarterly financial reports.[3] The requirements include reporting the number of

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[1] On the economic significance of actual repurchases, see, for example, Stephens and Weisbach (1998), Guay and Harford (2000), Grullon and Michaely (2002), Kahle (2002), Dittmar and Dittmar (2007), and Peyer and Vermaelen (2009).

[2] On the inaccuracy of pre-2004 publicly available repurchase data, see Cook, Krigman, and Leach (2003), and Banyi, Dyl, and Kahle (2008).

[3] SEC Rule 10b-18, which was adopted in 1982, provides a voluntary "safe harbor" from liability for manipulation, when an issuer or its affiliated purchaser bids for or purchases shares of the issuer's common stock, if they follow the rule's timing, price, and volume restrictions.

shares repurchased per month in the open market, and the average price per share the firm paid during the reporting period on a monthly basis.

In this paper we explore this new data source. We hand-collect information about actual repurchases of all S&P 500 firms from their 10Q and 10K filings for the years from 2004 to 2006, and investigate whether firms time their actual repurchases. In particular we are interested in learning 1) whether firms purchase their shares at discounted prices relative to prices paid by other investors during the repurchase month, 2) whether actual repurchase activity is followed by positive abnormal returns, 3) whether the market response to actual repurchase data information released is consistent with market timing, and 4) whether actual repurchases relate to insider trading in a manner indicating market timing.

We find clear evidence that only smaller S&P 500 firms repurchase their shares at lower prices, compared to other investors. Specifically, we sort our sample into three equal-size groups by firm size. While all S&P 500 firms are relatively large, the average firm size in the small-firm group is about one tenth of the average firm size in the large-firm group. The average monthly price that small firms pay for their stock is 0.416% below the average monthly market price, and the difference is statistically significant at the 1% level. However, for medium-sized and large firms, this difference is negligible and statistically insignificant. Small firms also tend to repurchase less frequently than large firms. On average, small firms repurchased in 47% of the reported months while large firms repurchased in 69% of the months. Repurchasing at lower prices is also related to liquidity. While liquidity is higher in repurchase months for all size groups (the bid-ask spread is narrower), controlling for size, lower bid-ask spread is associated with a

lower repurchase price relative to the market price. This, in turn, suggests that the more liquid the firm's market the better the firm's ability to buy at favorable prices, and that repurchasing firms consume liquidity rather than provide it.

While all firms increase their repurchase activity following price drops, we find that only for the small firms in our sample is actual repurchase activity followed by a positive and significant abnormal return that lasts up to three months. For large firms, the abnormal return is negative and insignificant. In fact, we show that a short-term strategy that focuses on the actual repurchase activity of the small firms can earn a monthly abnormal return of 0.9%, which is significant at the 1% level. We did not find positive abnormal returns in longer-term horizons (we considered returns for up to two years following the repurchase). Our analysis of the relation between repurchase and returns includes a Tobit-VAR model which is most appropriate due to inter-temporal dependencies and because repurchase data are censored. To our knowledge we are the first to utilize a Tobit-VAR analysis (described in detail in Appendix B).

Two important properties of stock buybacks are the transfer of wealth among shareholders if the stock is not fairly priced and the disbursement of free cash.[4] Our interpretation of the findings – that only small S&P 500 firms repurchase at discounted prices, have positive post-repurchase returns, and repurchase less frequently – is that only small firms time their repurchases to benefit from mispricing, whereas the repurchase activity of large firms is more focused on disbursement of free cash. Given that smaller firms are associated with higher information asymmetry, their motivation to repurchase strategically in order to benefit from underpricing is higher. Indeed we find that small

[4] For a survey of the theoretical literature about repurchases, see, for example, Allen and Michaely (2003).

firms are covered, on average, by half the number of analysts covering the large-firm group, and their forecast dispersion is double, suggesting substantial difference in information asymmetry between the small-firm and large-firm groups. At the same time, given that large firms tend to be mature, they are more strongly motivated to disburse free cash regardless of mispricing (e.g. because they do not have good investment opportunities for the cash they generate). Indeed we find that the average dividend yield of large firms is 30% higher than that of small firms, which is consistent with this interpretation, because in general, a larger dividend payout indicates stronger cash disbursement motivation. Also consistent with this interpretation, we find that market-to-book ratio, a common proxy for growth vs. value, is positively related to the price discount. That is, "value" or maturity (proxied by low market-to-book) is associated with less strategic repurchasing. Market-to-book, however, seems to be less significant than size in explaining the price discount, and is unrelated to post-repurchase returns.

The market response to disclosure of actual repurchase activity is consistent with our interpretation that only smaller firms time their actual repurchases. While firms are required to report actual repurchases only in the financial statements, they generally disclose their repurchase activity in the quarter several days earlier with their earnings announcement. We find the relation between earnings announcement abnormal return and actual repurchase activity to be positive and significant only for the small S&P 500 firms, suggesting the market responds to the information content of actual repurchase disclosure. We acknowledge that this relation does not necessarily imply that smaller firms repurchase to benefit from underpricing. It is possible that the smaller firms repurchase following positive information, not in order to benefit from underpricing, but

simply because they become informed of good information about the availability of free cash. The market receives the good information only when the actual repurchase data are disclosed, and hence the discounted repurchase prices, and the positive correlation between actual repurchase activity and future abnormal returns.

Given the information content in actual repurchase activity, one important question for investors and regulators is whether insiders time their personal trade in the stock with the firm's actual repurchases. Specifically, since insiders have control over the firm's repurchase activity and at the same time they are generally stock holders themselves, they might use repurchases to provide liquidity when they sell, in which case we would expect a negative relation between actual repurchases and insider trading (net buys). Alternatively, given that insiders are informed and control both actual repurchases and their personal trade, one would expect that when they are informed about mispricing, actual repurchases would be positively related to insider trading (net buys). Our findings here support the information motivation. That is, we find that actual repurchases and insider trading are positively correlated.

Overall, our findings suggest that only the repurchase activity of small S&P 500 firms is associated with timing and with wealth transfers among investors. Consistently, the market response to repurchase data revealed in earnings announcements is positive only for small S&P 500 firms. Insiders also seem to time repurchases with trade for their own portfolios based on information. Assuming monotonicity in the impact of firm size, and given that firms outside the S&P 500 are smaller, we expect our findings for small S&P 500 firms to be robust and significant also for repurchasing firms outside the S&P 500.

The remainder of this paper is organized as follows. Section 1 reviews related literature. Section 2 describes the data and the methodology. Section 3 provides sample statistics and examines how actual repurchases are related to firm characteristics and liquidity. Section 4 analyzes the relation between repurchase price and market price. Section 5 examines the relation between actual repurchases and past and future returns. Section 6 investigates how actual repurchases relate to earning announcements, and Section 7 investigates how they relate to insider trading. Section 8 concludes.

1. Literature Review

The general question of whether firms time their financial decisions has received considerable attention in the financial literature.[5] We investigate the timing of actual repurchase activity. Our novel contribution is in showing that the timing and consequences of actual repurchases strongly depends on firm size, and that the market response to the disclosure of this repurchase activity as well as insider trading are consistent with such timing. The most closely related studies include Ikenberry, Lakonishok, and Vermaelen (2000), Brockman and Chung (2001), Cook, Krigman, and Leach (2004), McNally, Smith, and Barnes (2006), Ginglinger and Hamon (2007), and De Cesari, Espenlaub, Khurshed, and Simkovic (2009).

[5] One line of studies considers stock issues. Baker and Wurgler (2002) show that equity issues predict market returns in the US, but Butler, Grullon, and Weston (2005) suggest that this predictive power does not stem from ability to time the market and exists because equity issues are simply the firm's reaction to market conditions. Like stock issues, repurchases may result in wealth transfer among the shareholders if timed to take advantage of mispricing. Henderson, Jegadeesh, and Weisbach (2006) find that in most countries firms time their equity issuances when the corresponding stock markets appear to be overvalued. Butler, Cornaggia, Grullon, and Weston (2011) find that the amount of net financing (i.e. issuance less repurchase) is better than issuance alone in predicting returns.

Cook, Krigman, and Leach (2004), (henceforth, CKL (2004)) investigate actual repurchases in the US before the regulation amendment using repurchase data disclosed voluntarily by 64 firms during a one-year period ending March 1994. With respect to repurchasing at discounted prices, they find that NYSE firms pay less than representative daily prices while NASDAQ firms pay more. We did not find any difference between NYSE firms and NASDAQ firms in terms of their ability to repurchase at favorable prices. This may be because we focus on S&P 500 firms, and hence our NASDAQ and NYSE firms are similar in size. Other studies also report that differences between NYSE and NASDAQ that existed in the 1990s disappeared in the 2000s, following changes in NASDAQ trading mechanisms. In a recent contemporaneous study, De Cesari et al. (2009) also investigate actual repurchase activity in the US using post-regulation-change data. Focusing on the impact of ownership structure, they show that at low levels of insider and institutional ownership the discount in repurchase prices relative to market prices is positively related to this ownership, whereas at high levels of insider and institutional ownership the situation is reversed. Their interpretation is that because insiders and institutions are better-informed investors, at low levels of ownership of these investors, their presence increases the incentive to repurchase based on information. However, at high levels of ownership of these informed investors, it becomes more difficult for the firm to benefit from information because competition with these informed investors in the financial markets is also more intensive. Brockman and Chung (2001) find that in Hong Kong firms repurchase at a lower cost than the cost that would result from a naïve accumulation strategy. McNally et al. (2006) show that firms in Canada repurchase at prices that are a remarkable 5.5% lower than prices paid by other investors.

CKL (2004) find that the bid-ask spread is narrower on repurchase days and interpret these findings as evidence that repurchases contribute to market liquidity. Outside the US, De Ridder and Rasbrant (2011) report narrower spreads on repurchase days in Sweden. In contrast, Brockman and Chung (2001), and Ginglinger and Hamon (2007) study the relation between the bid-ask spread and actual repurchases in Hong Kong and France, respectively. They report wider bid-ask spreads on repurchase days (months) and suggest this indicates that actual repurchases reduce liquidity.

Consistent with our findings, the literature documents that actual repurchase activity tends to increase following price drops.[6] The evidence about post-repurchase activity returns, however, is mixed. In the US, CKL (2004) do not find abnormal returns following actual repurchase activity, but a contemporaneous paper of De Cesari et al. (2009) finds positive abnormal returns consistent with our results. Outside the US, Zhang (2005) finds significant positive short-term abnormal returns following repurchase trade in Hong Kong, and Chung, Isakov, and Perignon (2007) report similar results in Switzerland. In Canada, Ikenberry et al. (2000), and McNally et al. (2006), also report price increases after repurchase activity. Ginglinger and Hamon (2007), however, find no significant price increases after actual repurchase activity in France. These studies do not consider the impact of firm size.

With respect to the relation between repurchases and insider trading, earlier investigations report a positive relation between program announcements and insider trading (e.g. Babenko, Tserlukevich, and Vedrashko 2011), and between actual

[6] For US evidence see CKL (2004) and De Cesari et al. (2009); Canada (Ikenberry et al. 2000, and McNally et al. 2006); Hong Kong (Zhang 2005); and France (Ginglinger and Hamon 2007).

repurchases and insider ownership/compensation (e.g. Kahle 2002 and Babenko 2009). Core, Guay, Richardson, and Verdi (2006) find that both insider trading and actual repurchases are negatively related to accruals. Andriosopoulos and Hoque (2011) find that in the UK both repurchases and insider purchases are used as means for supporting the stock price and signaling undervaluation. Bonaime and Ryngaert (2010) find that when insiders trade, repurchases are more frequently observed regardless of whether the insiders are selling or buying.

Lastly, it is worthwhile to compare our findings on actual repurchases to findings about the announcement of open-market repurchase programs in the US. Announcements of repurchase programs and their impact on prices and liquidity have been studied extensively (see for example, Vermaelen 1981, Comment and Jarrell 1991, and more recently, Grullon and Michaely 2004). Program announcements and actual repurchases are, however, different events. Most actual repurchase activity is spread over a period that lasts up to three years following the announcement, and announcing firms often repurchase much less or much more than the originally announced quantity (see Stephens and Weisbach 1998, Oded 2009, and Bonaime 2010). In addition, most firms have several concurrent and overlapping announced programs (see Jagannathan and Stephens 2003). In fact, announcements merely reveal that the firm may be "in the market," and are often only marginally connected to actual repurchase activity. Other studies of program announcements focus on long-run returns and find significant positive abnormal return in the years that follow the announcements (e.g. Ikenberry, et al. 1995, and Peyer

and Vermaelen 2009).[7] We, however, find no significant relation between actual repurchase and long-run returns. The difference in long-run returns between program announcements and actual repurchases may result because program announcements are substantially larger than actual repurchases in dollar volume and fraction of shares, and at the same time their frequency is substantially lower. Hence their impact on future returns lasts for a longer time. Alternatively the difference in long-run returns may result from enhanced disclosure associated with the regulation change or because our sample is more recent.

2. Data

Our initial sample comprises the 500 firms that were included in the S&P 500 in January 2004. The sample period covers the 36 months between January 2004 and December 2006. The repurchase data were obtained from filings to the SEC in 10Q and 10K forms, available on the SEC website (www.sec.gov). The data retrieved from these filings include the firm name, ticker, number of shares repurchased, and the average repurchase price during the month. Data on outstanding shares, prices, and returns (adjusted for splits and dividends) were obtained from the CRSP. The data sets (obtained from the SEC and CRSP) were merged based on firm ticker. From the original sample of 500 firms, we eliminated firms that were delisted and therefore had no filings available on www.sec.gov.[8] We also eliminated firms with erroneous repurchase data and firms that

[7] Billet and Yu (2011) show that post-announcement returns increase in information asymmetry about the firm, consistent with our findings for actual repurchases.

[8] Reports of delisted firms were not found in a standard search procedure of sec.gov and therefore these firms were not included in our study.

could not be matched correctly with the CRSP data, resulting in 470 firms. Of these 470 firms, 416 reported repurchase activity in SEC filings during the sample period ("repurchase firms") while 54 firms reported no such activity ("non-repurchase firms").

In December 2003, the Securities and Exchange Commission adopted several amendments to Rule 10b-18 to enhance the transparency of actual repurchase activity. Following the amendments, firms are required to disclose in quarterly and annual reports all repurchases of equity securities in the last fiscal quarter. Thus, since 2004, this information is publicly available through the 10Q and 10K reports. Stock repurchase transactions are generally reported under the heading "Issuer Purchases of Equity Securities." For each month of the quarter, the firm reports: the total number of shares repurchased, the average repurchase price, the number of shares repurchased under a publicly announced repurchase program, and the number of shares remaining in its announced repurchase program at the end of the month. An example of actual repurchase reporting to the SEC is provided in Appendix A.

For the 416 firms for which repurchase data were available in 10Q and 10K filings, several monthly observations were stated as repurchases at special prices not performed through the open market (such as tender offer repurchases, privately negotiated repurchases, and repurchases directly from managers). These monthly observations were eliminated from the sample.[9] Sixteen monthly observations were also removed after a review of the financial report revealed that they were accelerated stock

[9] Under the new requirements of Rule 10b-18, a firm is required to briefly disclose in a footnote the nature of the repurchase transaction. We used these footnotes to eliminate from the sample those transactions that were not performed through the open market. We also used these footnotes to clean the impact of those transactions on the average repurchase price whenever applicable, or eliminate the transaction when such an adjustment was not possible.

repurchase transactions rather than open-market repurchases, even though they were reported under open-market transactions.[10] Price outliers were also removed using the following rule: If the average monthly repurchase price reported by the firm fell outside the daily high-low range during the month, the observation was removed (232 out-of-range monthly observations were removed under this rule).

The repurchase prices and quantities were adjusted for splits and dividends. Several firms did not have return data for all 36 months because they were delisted (for various reasons). We adjusted these firms' returns for the specific delisting month using CRSP delisting returns data.[11] The final sample consists of 16,526 monthly observations from 470 firms, of which 8,501 are non-zero repurchases. Out of the 470 firms in the final sample, 416 had at least one repurchase observation reported during the sample period. For these 416 firms we have 14,669 observations (of which 8,501 are non-zero).

3. Sample Statistics

Table 1 reports general characteristics of the firms in the sample. Panel 1A provides statistics of the complete sample of 470 firms. In the table, *Mean* is the average of the firm-level averages, *Median* and *Std* are the median and standard deviation of the firm-level averages, respectively. The mean (median) firm size is about $22.3 ($10.7) billion, and the mean (median) monthly dividend yield is 0.13% (0.11%). The mean (median) monthly return is positive at 1.11% (1.09%). The mean (median) monthly *Alpha*

[10] Accelerated stock repurchase transactions were removed from the sample because they are performed in the open market over several months after they are reported.
[11] Adjusting for delisting is important when comparing portfolio performance. Not including the delisted returns causes upward bias in the portfolio performance. For further discussion see Shumway (1997).

abnormal return, measured using a 4-factor model which includes the three Fama-French (1993) factors and the Carhart (1997) momentum factor, is negative at -0.18% (-0.06%). The mean (median) monthly market volume is $2,671 ($1,489) million.

Panel 1B provides statistics of repurchasing vs. non-repurchasing firms. Of the 470 firms, 416 (89%) had at least one month of repurchase activity whereas 54 (11%) had no repurchases reported in SEC filings during the sample period. The panel shows that the *Size* (market capitalization) of the repurchasing firms is twice that of the non-repurchasing firms, and that the difference is statistically significant.[12] *Dividend Yield* and *Alpha* (abnormal return relative to four factors) are also significantly higher for repurchasing firms. However, *Ret* (naïve return) is not significantly higher for repurchasing firms and the difference in *Market Volume* is significantly higher for repurchasing firms only under the Wilcoxon measure. These findings are consistent with earlier documentations of repurchase activity in the literature.

Because we focus on S&P 500 firms, naturally most of the firms in the sample are NYSE rather than NASDAQ firms. Of the 470 firms in the sample, 398 (84.7%) are from NYSE and 72 (15.3%) are from NASDAQ.

Table 2 reports statistics of repurchase activity. The characteristics are equally weighted across all 8,501 repurchase months of the 416 firms that had repurchase activity during the sample period. The average (median) amount spent on repurchasing shares, in a month in which the firm did repurchase, is $104 million ($27 million). The mean (median) market volume in repurchase months is $3,244 million ($1,725 million). In repurchase months, monthly repurchase trade accounts for 3.3% of the monthly dollar

[12] The standard deviation of the market capitalization of non-repurchasing firms is high because of WalMart, with a market capitalization of $285 billion.

volume of trade in the stock, and for about 0.41% of the market capitalization. The medians of the repurchase activity variables we consider tend to be low relative to their means, indicating positive skewness. The standard deviations of the variables tend to be high relative to their means.

In **Table 3** we investigate the dependency of repurchase characteristics on firm size. Specifically, we sort the 416 repurchasing firms into three equal-size groups by their average size (market capitalization) over the sample period. Panel 3A reports firm characteristics while Panel 3B reports payout characteristics of the different size groups. The bottom three rows in each panel report the difference between the large-firm group and the small-firm group, and the statistical significance of the difference using *t*-statistics and the Wilcoxon non-parametric test. Starting with Panel 3A, firm-size ranges are \$0.5-\$7.6 billion in the small-firm group, \$7.6-\$18 billion in the medium-sized firm group, and \$18-\$357 billion in the large-firm group. Thus, while all S&P 500 firms are relatively large, the average firm size in the small-firm group is about one tenth of the average firm size in the large-firm group. Panel 3A also reports firm characteristics across firm-size groups. The half bid-ask spread (*HBAS*), decreases from 0.046% in the small-firm group to 0.028% in the large-firm group, and the difference is statistically significant at the 1% level. The negative correlation between firm size and *HBAS* is consistent with larger firms being more liquid. *RetStd* is the standard deviation of the return, and is naturally negatively correlated with size. *Number of Analysts* and *Dispersion of Analysts* are, respectively, the number of analysts covering the firm, and the dispersion of their quarterly earnings forecast, normalized by the forecast mean, and calculated based on monthly updates of forecasts from IBES. Naturally, larger firms have

more coverage because they attract greater investor interest, and show less dispersion in analyst forecasts due to lower information asymmetry. As our sample consists of only S&P 500 firms, both small and large firms have a relatively high number of analysts covering them. Note, however, that the average number of analysts covering small firms is about half the number of analysts covering large firms (11.8 vs. 19.1, respectively). The dispersion in the analysts forecasts for small firms is double that of the large firms (0.16 vs. 0.08, respectively). The differences between the groups in number and in dispersion of analysts are both statistically significant.

In the literature, market-to-book ratio is often used as a proxy for growth opportunities, a high market-to-book ratio indicating growth firms and a low market-to-book ratio indicating value firms. The last column of Panel 3A reports the average market-to-book ratio (*MB*) of the firms in each size-group and for the complete sample. We calculate *MB* following Grullon and Michaely (2002) for each firm as the average of its annual market-to-book ratio over the sample period, where for each year market-to-book is equal to book value of total assets plus market value of equity minus book value of equity, scaled by book value of total assets and then averaged over the firms in the sample. As the results show, there is no significant difference in *MB* across the size groups. This in turn indicates that differences across the size groups are not a reflection of differences in *MB* (i.e. growth firms vs. value firms).

In Panel 3B we focus on payout characteristics of the different size-groups. The first variable we consider is the repurchase frequency. We suggest that repurchase frequency is a measure of strategic repurchasing (timing) where the lower the repurchase frequency the more strategic the repurchase. We report the average repurchase frequency

(*RepFreq*) across firm groups, *RepFreq* being the ratio between the number of months in which a given firm reported a positive repurchase value and the total number of months in which it appears in the sample. As Panel 3B indicates, larger firms repurchase more frequently: Repurchase frequency is 47% in the small-firms group and 69% in the large-firm group, and the difference is statistically significant at the 1% level. Interestingly, repurchase dollar volume relative to market dollar volume (*ReptoMktVol*) is similar in all groups: 3.7%, 3.0%, and 3.3% for small, medium-sized and large firms, respectively. The monthly dollar value of a firm's repurchase as a percentage of the firm's preceding month market capitalization (*Rep/Size*), namely, "the repurchase yield" is also similar across the firm-size groups. In sum, the results indicate that small firms repurchase less frequently relative to large firms, suggesting that relative to large firms they are more concerned with the timing of their repurchases. However, in repurchase months, the repurchase dollar value relative to market volume or size is similar across firm-size groups.[13]

Dividend Yield is the monthly dividend yield represented as a percentage. As Panel 3B shows, unlike the repurchase yield (*Rep/Size*), the dividend yield increases with firm size. The average monthly dividend yield in the large-firm group is 21% greater than that in the small-firm group (0.148% vs. 0.122%, respectively). The *t*-statistics of the difference in the dividend yield between the large-firm and small-firm groups is 1.86, and the Wilcoxon measure is 2.68. The difference in the *Total Payout Yield*, which is the sum of *Rep/Size* and the *Dividend Yield*, is, however, insignificant. The last three columns of Panel 3B report the significance of payout across the size groups relative to earnings (ratio) rather than market value (yield). The findings for the payout ratios (repurchase,

[13] Note, however, that large firms repurchase more frequently and hence they repurchase a larger fraction of their value/number of shares relative to small firms.

dividend and total payout) are similar to the findings for the yield, that is, while the difference in *Dividend Payout Ratio* between the large-firm group and the small-firm group is statistically significant, the differences in *Repurchase Payout Ratio* and *Total Payout Ratio* are not. With the exception of *ReptoMktVol* and *HBAS* (Panel 4A), which are calculated based on 8,501 repurchase months, all variables in Table 3 are calculated based on the complete sample of 14,669 observations (repurchase and non-repurchase months).

We also investigated differences in actual repurchases between fiscal quarters and between months within the quarter for the 416 firms that did have repurchase months. Our findings here (not tabulated) suggest there is no significant difference in actual repurchase activity among the fiscal quarters, either for the complete sample or for each of the size groups. However, we found systematic variability in repurchase activity within the quarter months. Specifically, for the complete sample, the average repurchase activity in the first month of the quarter is 0.155% of the shares while it is 0.29% and 0.235% for the second and third months of the fiscal quarter, respectively. The difference is significant at the 1% level. (Results here were obtained using the Wald test with clustering.) The qualitative results are similar for each of the size groups.

In **Table 4** we focus on the relation between repurchase and liquidity. We include only firms that have both repurchase months and non-repurchase months. Of the 416 firms with at least one month of repurchase activity, 22 repurchased in all months reported, so the analysis in Table 4 is based on 394 firms. We measure liquidity using the half bid-ask spread (*HBAS*). The volume of trade in dollars is also reported in the table (*MktVol*). Rows (1) to (6) report the results for the average values of *HBAS* in repurchase

vs. non-repurchase months. The results show that *HBAS* is significantly lower in repurchase months relative to non-repurchase months. Specifically, the average half bid-ask spread is 0.038% in non-repurchase months and 0.036% in repurchase months. The difference amounts to approximately 5% of the spread, and is statistically significant at the 1% level.[14] As the table shows, *MktVol* is also higher in repurchase months relative to non-repurchase months. However, the difference is insignificant.

Rows (7) to (10) of Table 4 report the results of a binomial test of the relation between repurchasing and liquidity. For each of the variables *HBAS* and *MktVol*, we counted the number of firms for which the average value of the variable in repurchase months less the average value in non-repurchase months is positive, and the number of firms for which it is negative. As Table 4 demonstrates, there are 253 firms (64%) for which average *HBAS* in repurchase months was lower than in non-repurchase months (a negative difference in *HBAS*) but only 141 firms (36%) for which average *HBAS* in repurchase months was higher than in non-repurchase months (a positive difference in *HBAS*). There were 159 firms (40%) for which average *MktVol* in repurchase months was lower than in non-repurchase months (a negative difference in *MktVol*) and 235 firms (60%) for which average *MktVol* in repurchase months was higher than in non-repurchase months (a positive difference in *MktVol*). As the bottom row of Table 3 indicates, the difference in the number of firms is statistically significant at the 1% level for both *HBAS* and *MktVol* (confirmed with a binomial distribution test under the assumption of equal

[14] The absolute difference is small because the bid-ask spreads in the sample are small. This is in turn due to the decimalization of the quotes in the NYSE and NASDAQ exchanges that occurred in 2001, and because the sample comprises S&P 500 firms. Our estimation of the difference is also likely downward-biased because firms repurchase only on a subset of the trading days in each month, while we average the bid-ask spread over all the days of each month.

chance for positive and negative outcomes). The results of this non-parametric test are thus consistent with the results reported for the *t*-statistics of *HBAS* and *MktVol* in repurchase months vs. non-repurchase months. We repeated the analysis in Table 4 separately for each of the size groups and there was no qualitative difference in the findings for each size group. Overall the results in Table 4 indicate that actual repurchase activity is negatively related to the bid-ask spread, and positively related to market volume. Both findings suggest that repurchase activity is positively correlated with liquidity regardless of firm size.

4. Repurchase Price Analysis

In this section we investigate whether firms repurchase their shares at prices below the current market price. We expect that repurchasing at favorable prices will be a challenge for firms because of the requirements of SEC Rule 10b-18. Specifically, Rule 10b-18 requires that the firm refrain from bidding up the price, that is, firms cannot post a buy-limit order that is higher than the current bid or the most recent independent trade (the higher of the two). Thus, if a firm tries to benefit from private information, it is at a disadvantage relative to other traders because its trading strategy is restricted.

4.1 Average Repurchase Price Relative to Market Price

We start by considering the naïve difference between the average monthly repurchase price and the average monthly market price. The average monthly repurchase price we obtained from the financial reports is adjusted for dividends and splits using the CRSP price adjustment factor. Following CKL (2004), we define our variable of interest, *Diff*

(in %), for firm *i* in month *t*, as the month-average repurchase price paid by the firm (*RepPrc*) less the month-average market price (*MktPrc*) divided by the average market price. Specifically,

$$Diff = (RepPrc - MktPrc) / (MktPrc),$$

The month-average repurchase price, *RepPrc*, is from the firm's financial report and the month-average market price, *MktPrc*, is calculated as the value-weighted average of the CRSP daily close prices based on daily trade volume. [15] Both *RepPrc* and *MktPrc* are adjusted for dividends and splits. A negative *Diff* means that the firm repurchased at a price lower than the market price, on average. A positive *Diff* means the opposite. In our analysis of *Diff*, we start with simple statistics, and then investigate the dependency of *Diff* on various explanatory variables.

Table 5 reports averages and *t*-statistics of the *Diff* measure. In Panel 5A we report *Diff* for the different firm-size groups considered in Table 3. The market price input for *Diff* is the market price from CRSP, value weighted within the month based on daily trade volume. In Column (1) the average *Diff* is reported equally weighted based on the *Diff* averages of the 416 repurchasing firms, each firm's *Diff* average being calculated equally weighted over the firm's monthly differences. In Column (3) average *Diff* is reported equally weighted based on all 8,501 repurchase observations. For completeness we also report the results for the complete sample at the bottom of the table.

The results indicate that only small firms repurchase their stock at prices lower than the market price. When *Diff* is calculated based on the 416 repurchasing firms, with

[15] Results using the average of the open and close prices or the average of the daily high and low prices, instead of close prices, or equally weighted instead of value weighed are qualitatively similar.

firms being equally weighted (Column (1)), *Diff* is -0.416 (i.e. 0.416%) in the small-firm group and statistically significant at the 1% level. It is substantially higher than the average bid-ask spread of small firms (of 2*0.046%=0.092%, see Table 3) indicating the discount is not just the spread. However, in the medium-sized and large-firm groups *Diff* is merely -0.024 and -0.010, respectively, and statistically insignificant. The results are qualitatively similar when *Diff* is calculated equally weighted over observations rather than over firms (Column (3)).[16] These findings suggest that, on average, small S&P 500 firms buy at favorable prices, while large S&P 500 firms do not.

Given earlier evidence that repurchase activity is related to market-to-book (e.g. Grullon and Michaely 2002, and Peyer and Vermaelen 2009), in Panel 5B we repeat the analysis of *Diff* sorting the sample by market-to-book (henceforth "MB") instead of size. We partition the sample into three equal-size groups by MB: low-MB firms, medium-MB firms, and high-MB firms. MB is calculated as in Grullon and Michaely (2002). As Panel 5B shows *Diff* is negative and significant in the medium and high-MB firms but not in the small-MB firms. When we double sort first based on MB and then based on Size (I.e., three size groups for each MB group) *Diff* is still significantly more negative in the small-size group relative to the large-size group. However, when we first sort based on size and then based on MB (not in the table), *Diff* is not significantly different across MB groups. Thus, while repurchasing at discounted prices (negative *Diff*) is generally associated with high MB, it seems that size is more significant in explaining the discount.

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[16] The results are also qualitatively similar when the calculated *Diff* is weighted by the dollar value of the repurchase rather than equally weighted. To alleviate a possible concern that the results are driven by outliers, we also looked at the size groups medians instead of averages. The results for the median discount (using Mann-Whitney non-parametric test and or simulated *t*-statistics using bootstrapping of medians) are also qualitatively similar.

4.2 Determinants of the Difference between Repurchase Price and Market Price

In this subsection we conduct a multivariate regression analysis of the difference between repurchase price and market price (the *Diff* measure). We consider the following explanatory variables. *LnSize* is the natural log of the average market capitalization of the firm over repurchase months. *HBAS(t-1)* is the 1-month lag of the bid-ask spread. *RepFreq* is the ratio of repurchase months to total number of months the firm has in the sample. *LnMB* is the natural log of the firms market-to-book (MB) ratio, where MB ration is calculated as in Grullon and Michaely (2002) using Compustat yearly data, with Pontiff and Woodgate's (2008) approach to missing values.[17] *RetStd(t-1)* is the 1-month lag of the return standard deviation.[18] *Rep/Size* is the ratio between the monthly repurchase dollar value and the market capitalization of the firm in the previous month. *ReptoMktVol* is the ratio between the average monthly repurchase dollar value in the stock and the average monthly market dollar value of trade in the stock.

Table 6 provides results of regression analysis of *Diff*, the difference between average monthly repurchase price and average monthly market price. The analysis is based on 8,501 repurchase observations. In the calculation of *Diff*, the monthly repurchase price is taken from the firm's financial reports, and the monthly market price

[17] First, stocks with negative or missing values of book-to-market get the value of 0. The book-to-market variable thus includes stocks with a logarithm of the positive book-to-market and stocks with zero values. Then a dummy variable (*BMdum*) takes the value of 1, whenever the book-to-market exists and is positive; and otherwise, takes a value of 0. Finally, in the regressions, both the dummy and the book-to-market variable are included.

[18] We are interested in the manner in which *Diff* depends on the characteristics of the firm. Accordingly, for *HBAS* and *RetStd* we use the 1-month lags rather than contemporaneous variables in order to avoid the contemporaneous dependencies between these variables and *Diff* that could impact our results.

is the calculated value weighted by trade volume over the daily market closing price from CRSP.

Recall that according to the definition of *Diff*, the more negative *Diff*, the more favorable the price at which the firm repurchases. Accordingly, the more negative the coefficient of the control variable, the lower the price at which the firm is buying. The coefficient of *LnSize* is positive and significant in all regressions, suggesting that small firms repurchase shares at lower prices relative to large firms, consistent with our findings in Table 5. This result holds even when we control for liquidity using *HBAS(t-1)*, the 1-month lag of *HBAS* (see regression (2)). The coefficient of *HBAS(t-1)* is positive and significant after controlling for size in all regressions, suggesting that given size, the more liquid the market, the more able the firm is to buy at favorable prices. The coefficient of *RepFreq*, the ratio between repurchase months and total months, is positive and significant in all regressions, indicating that firms that repurchase frequently do not do so at favorable prices. The coefficient of *LnMB* is negative and significant in all regressions suggesting that growth firms are better than value firms at repurchasing at discounted prices. The coefficient of *RetStd(t-1)*, the 1-month lag of the standard deviation of the return, is insignificant, suggesting that the standard deviation of return is unrelated to the firm's ability to repurchase at favorable prices. Lastly, the coefficients of *Rep/Size*, the ratio between the firm's monthly repurchase volume and market capitalization, and *ReptoMktVol*, the ratio between the monthly repurchase dollar value and the monthly market dollar volume, are both insignificant, suggesting that the amount repurchased does not affect the firm's ability to purchase at favorable prices, either when scaled by market capitalization, or when scaled by market volume of trade.

When we repeated the analysis in Table 6 using one observation per firm (the firm averages of the dependent and explanatory variable) instead of a panel of 8501 observations the results were qualitatively similar. In sum, the regression results in Table 6 support our interpretation of the results in Table 5 that smaller firms and growth firms (high-MB firms) are more capable of buying at favorable prices within the month.[19]

4.3 Discussion of Findings about Repurchase Activity Characteristics

We summarize the main findings in Sections 3 and 4 as follows:

- Small firms repurchase less frequently than large firms (Table 4).
- Small firms repurchase at favorable prices within the month; large firms do not (Table 5 and Table 6).
- Repurchase activity is positively related to liquidity; after controlling for size, the price discount is positively related to liquidity. (Table 3 and Table 6).

We suggest the following interpretation of these findings. Small firms repurchase strategically depending on market conditions; they therefore repurchase at favorable prices within the month and profit from mispricing. Because they repurchase strategically, their repurchases are infrequent. Large firms do not repurchase strategically, but rather repurchase on a regular basis. They do not aim to buy at favorable prices, and are more focused on the execution of their repurchase programs. As a result, their

[19] Turnover, a commonly used as a measure of liquidity, was insignificant in all regressions when included.

purchases are frequent and executed at prices which are, on average, close to the average market price.

Why do small firms differ from large firms in their repurchase characteristics? It is possible that because information asymmetry is high for small firms, repurchasing in order to benefit from information dominates repurchasing for free cash disbursement. In contrast, information asymmetry for large firms is low, and they are therefore not motivated by benefits from information. Large firms also tend to be more mature, and hence their motivation to repurchase in order to disburse free cash is likely stronger. Indeed, Table 6 suggests that the lower the market-to-book, the lower the price discount, consistent with this interpretation.

It has been suggested to us that large firms delegate their repurchase activity to a broker, while smaller firms tend to repurchase "in house," consistent with our interpretation that only smaller firms repurchase strategically. However, we were not able to find documentation that confirms this.

Because our study cannot indicate causality, we cannot state whether the negative correlation found between repurchase volume and the bid-ask spread (Table 3) is because firms tend to repurchase when the bid-ask spread is low or because repurchases reduce the bid-ask spread. That is, we cannot infer from the negative correlation found between repurchase volume and the bid-ask spread whether repurchasing firms consume liquidity or provide it. However, Table 6 indicates that after controlling for size, the bid-ask spread is positive and significant in explaining *Diff* (i.e. a higher bid-ask spread means higher purchase prices relative to the market price). This, in turn, suggests that repurchase trade consumes liquidity rather than provide it, because a liquidity consumer is adversely

affected by the bid-ask spread, whereas a liquidity provider benefits from the bid-ask spread.[20]

Lastly, the notion "benefit from underpricing" deserves further clarification. Because repurchase is a zero-sum game, it is always the case that some shareholders gain at the expense of others. More specifically, when the firm repurchases to benefit from underpricing it is the staying shareholders that gain at the expense of the selling shareholders. We assume that managers will side with the staying shareholders because their future compensation will be determined by the staying shareholders and because managers tend to be staying shareholders themselves. Accordingly, our focus is the wealth of the staying shareholders.[21]

5. Actual Repurchase and Stock Price Performance

The results in Section 4 indicate that small firms are able to repurchase shares at favorable prices relative to monthly averages. They do not tell us, however, what firms, if any, also benefit from this execution strategy in the post-repurchase period. For example, if large firms are better informed about their future performance, they might be buying at less favorable prices in order to benefit from post-repurchase price appreciation. In this section we investigate the manner in which repurchase activity is related to past returns and future returns. For this purpose we conduct several tests, utilizing several regression and vector auto regression (VAR) models.

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[20] McNally and Smith (2010), however, find that in Canada most repurchase orders are limit orders and hence suggest that repurchases provide liquidity. In the US, data on order type (limit or market) are not publicly available.

[21] Whose value the firm is maximizing, the staying shareholders or the departing shareholders, is an open question in corporate finance (see Dybvig and Zender, 1991).

5.1 Determinants of Monthly Repurchase Activity – Regression Analysis

We investigate how current repurchase activity depends on past returns. In addition we consider the manner in which current repurchase activity depends on other factors such as the bid-ask spread and past repurchase activity. Because repurchase data are censored, in the analysis, we utilize both Tobit and Probit models. A detailed description of the Tobit and Probit procedures we use appears in Appendix B.

Table 7 reports results for Tobit and Probit analysis of monthly share repurchase on past returns. We run several specifications. The dependent variable in all regressions is *Rep/Size*, the monthly fraction of shares repurchased, measured as the ratio between the dollar value of repurchase reported and the market capitalization of the firm. We use the following notation for the independent variables. *Ret* is the repurchase-month return, and *HBAS* is the average half bid-ask spread in month *t*. *HBAS (t-1)* is the half bid-ask spread in the month preceding repurchase. The other lagged independent variables are named in a similar manner. In order to measure the change in the dependent variable resulting from a unit change in any independent variable, we need to estimate the variables' marginal effects. This is because we are estimating non-linear models (Tobit and Probit as opposed to a standard OLS). The marginal effects are usually estimated at the mean of the explanatory variables.[22]

Panels 7A and 7B of Table 7 report the Tobit model and Probit model results, respectively. Both panels report the marginal effects of the independent variables (which

[22] Unlike in Table 6 where our interest is variation across firms (of *Diff*) , in Table 7 our interest is within firm variation (of repurchase), and hence in Table 7, in addition to time dummy variables we also include firm dummy variables.

are a function of the estimated parameters, and reflect their impact on the dependent variable). Starting with Panel 7A (Tobit model) the marginal effects of *Ret* and *HBAS* are negative and statistically significant when these variables are considered alone or together (regressions (1) through (3)). The marginal effect of *HBAS(t-1)* is, however, insignificant (regression (4)). The marginal effect of *Rep/Size(t-1)*, the 1-month lagged fraction of shares repurchased is positive and significant (regressions (5) and 7)), and the marginal effect of *Ret(t-1)*, the 1-month lagged return is negative and significant (regressions (6) and (7)). When we use three lags of *Rep/Size* and three lags of *Ret* together in regression (8), the explanatory variables lagged *Rep/Size* in months *t-1*, t-3, and lagged *Ret* in months *t-1* and *t-2* are significant.[23] *HBAS* and *Ret* are also significant when these variables are included (regressions (9) and (10)). The results of the Probit model (Panel 7B) are qualitatively similar.

To gain a sense of the implied economic magnitude, consider the impact of a change in *Ret(t-1)* on the change in *Rep/Size*. Recall that the average *Ret* is 1.16% (see Table 1, Panel 1B), and consider, for example, specification (6) of Panel 7A (Tobit model). The coefficient of *Ret(t-1)* is -0.004. Thus, estimating the marginal effect at the average values, an increase of one standard deviation (6.46%)[24] in *Ret(t-1)*, from 1.16% (see Table 1, Panel 1B) to 7.62%, will result in a decrease of -0.027% in *Rep/Size*, from 0.233% (see Table 4, Panel 4A) to 0.206%, or a decrease of about 10% in *Rep/Size*. Overall the findings in Table 7 suggest that a decrease in the previous month return

[23] Stephens and Weisbach (1998) find that current quarter repurchase is negatively related to past quarter return, consistent with our findings here. However, their findings concerning the relation between current quarter repurchase and past quarter repurchase are inconclusive.

[24] We calculate the average firm-level standard deviation (not tabulated) to be 6.46%, as opposed to the standard deviation of the mean which is 1.16% as reported in Table 1, Panel 1B.

results in a positive and significant increase in repurchase activity. Moreover, note that earlier lags of return also impact *Rep/Size*. We will further investigate this dynamic relation in the next section using a vector auto regression model that includes both actual repurchases and returns as dependent variables (a bivariate VAR model). We also repeated the analysis for the different firm-size groups considered in Section 4. There were no significant differences between the size groups. That is, repurchase activity increases following a price drop regardless of firm size.

Our interpretation of the results in Table 7 is that the more negative the return, the more the firm repurchases. Firms seem to respond to a price drop by increasing their repurchase activity starting from the month of the drop in price. This relation between negative return and repurchase activity fades after approximately three months.[25]

Because firm characteristics such as market-to-book, leverage, cash, and dividend yield change very slowly we do not expect them to affect repurchase activity at the firm level on a monthly basis, and hence we did not include them in Table 7. Still, we have verified that our results at the cross-section of firms are consistent with the literature (e.g. Dittmar 2000, Table 5). Specifically, following the Dittmar methodology, we find that at the cross-section of the 416 firms in our sample repurchase activity declines with market-to-book, leverage, and dividend yield, and increases with cash flow.

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[25] We also investigated the significance of turnover (market dollar volume/outstanding shares) in month *t*. Turnover was significant in the Tobit model, consistent with our earlier results that actual repurchase activity is positively correlated with liquidity. In the Probit model turnover was insignificant.

5.2 The Dynamic Relation between Repurchase and Return

We next turn to investigating the dynamic relation between actual repurchase activity and return utilizing a bivariate vector auto regression (VAR) model. The main advantage of a VAR model over a standard regression model is the dynamic setup used to capture the evolution and interdependencies between the variables. Because repurchase data are censored (repurchase values can only be nonnegative) a Tobit-VAR model is more appropriate than an OLS-VAR model. Accordingly, our analysis utilizes a Tobit-VAR. To our knowledge we are the first to develop a Tobit-VAR model. The procedure is described in detail in Appendix B.

The repurchase variable utilized in all the VAR models we consider is *Rep/Size,* the ratio between the repurchase dollar value in month *t* and the market capitalization of the previous month. We use two different measures for return: The first measure is *Alpha*, the monthly abnormal return, calculated using a 4-factor model that is based on the three Fama-French (1993) factors and the Carhart (1997) momentum factor. *Alpha* is calculated out of sample as in Brennan, Chordia, and Subrahmanyam (1998). The second measure we use is *Ret,* the return in month *t*. Both *Alpha* and *Ret* are adjusted for delisting as in Shumway (1997).

We sort all our 416 repurchasing firms into three equal-size groups, based on the firms' average market capitalization over the sample period. We denote the group with the smallest firm size as small firms, the middle group as medium-sized firms, and the group with the largest firms as large firms. For each group we then estimate a Tobit-VAR model, i.e. a VAR model in which the return equation (*Alpha* or, alternatively, *Ret*) is estimated using an OLS model and the *Rep/Size* equation is estimated using a Tobit

model. The models are estimated with three lags of *Rep/Size* and three lags of return (*Alpha*, or alternatively, *Ret*). This is because our results in Section 5.1 suggest that the mutual impact of repurchase and return lasts for up to three months.[26] After the model is estimated, we estimate the impulse response of *Rep/Size* to a shock in *Alpha* and a shock in *Ret*, and the impulse response of *Alpha* and *Ret* to a shock in *Rep/Size*. We focus primarily on *Alpha* but report our findings also for *Ret*.

Table 8 reports our findings for the smallest and largest groups (small firms and large firms, respectively). In Panel 8A we report the cumulative impulse response of *Rep/Size* to negative shocks in *Alpha* and *Ret*. Columns (1) and (2) report the impulse response of *Rep/Size* to a negative one-standard-deviation shock in *Alpha* for the small-firm group and the large-firm group, respectively. For both small and large firms, the impulse is positive from the start and statistically significant. The cumulative magnitude is approximately the same for small firms and large firms (0.31% vs. 0.27%, respectively). Columns (3) and (4) of Panel 8A report the impulse response of *Rep/Size* to a negative one-standard-deviation shock in *Ret* for the small-firm group and the large-firm group, respectively. The response is statistically significant for both groups. The cumulative magnitude of the impulse response is four times greater for small firms than for large firms (0.12% vs. 0.03%, respectively).

Figure 1 depicts the impulse response of repurchase to a shock in return (abnormal and naïve) for small firms and large firms, as reported in Panel 8A of Table 8. Graphs 1A and 1B depict the impulse response of *Rep/Size* to a negative one-standard-deviation shock in *Alpha* for the small-firm group and the large-firm group reported in

[26] Indeed, we also considered VAR models that include six lags of *Rep/Size* and *Ret*. The results under these models were qualitatively similar to the results obtained with 3-lag VAR models.

Columns (1) and (2) of Panel 8A, respectively. The middle line in the graphs is the impulse response and the top and bottom lines are 5% confidence intervals, calculated using a simulation of 100,000 draws (see Appendix B). Graphs 1C and 1D depict the impulse response of *Rep/Size* to a negative one-standard-deviation shock in *Ret* for the small-firm group and the large-firm group reported in Columns (3) and (4) of Panel 8A, respectively. As the graphs show, the results for a shock in *Ret* are qualitatively similar to the results for a shock in *Alpha*.

In Panel 8B we report the cumulative impulse response of *Alpha* and *Ret* to a positive shock in *Rep/Size*. Columns (1) and (2) report the impulse response of *Rep/Size* to a positive one-standard-deviation shock in *Alpha* for the small-firm and large-firm groups, respectively. The results suggest that the response is positive only for the smaller firms. The positive response reaches 0.62% for small firms and is highly significant, with a *t*-statistic of 2.07. For large firms the cumulative response is -0.12% and is not statistically significant. Columns (3) and (4) of Panel 8B report the impulse response of *Ret* to a positive one-standard-deviation shock in *Rep/Size* for the small-firm and large-firm groups, respectively. The response of *Ret* for small firms is at 0.69%. For large firms it becomes stable at only 0.07% and is not statistically significant. Overall, the results for *Ret* are qualitatively similar to the results for *Alpha*.

Figure 2 depicts the impulse response of return (abnormal and naïve) to a shock in repurchase for small firms vs. large firms, as reported in Panel 8B of Table 8. Graphs 2A and 2B depict the impulse response of *Alpha* to a positive one-standard-deviation shock in *Rep/Size* for the small-firm group and the large-firm group reported in Columns (1) and (2) of Panel 8B, respectively. As the graphs show, the response is positive for small

firms and about zero for large firms. The 5% confidence intervals indicate that the response of the small-firm group is positive even for the lower confidence interval, while the response of the large-firm group is strongly negative. Graphs 2C and 2D depict the impulse response of *Ret* to a one-standard-deviation shock in *Rep/Size* for the small-firm and the large-firm groups reported in Columns (3) and (4), respectively, of Panel 8B. As the graphs show, the response of *Ret* to a shock in *Rep/Size* is qualitatively similar to the response to a shock in *Alpha*. We also repeated the VAR analysis using groups formed based on MB rather than size. In this case, the impulse response was insignificant for all three MB groups, and there was no significant difference in the impulse response between high-MB and low-MB firms.

The results of the VAR analysis suggest that negative returns stimulate higher repurchase activity for both small and large S&P 500 firms. However, repurchase activity results in positive subsequent returns only for smaller S&P 500 firms. These findings and our findings in Section 4 (that smaller S&P 500 firms repurchase at a discount relative to the average market price while larger S&P 500 firms do not) suggest that small firms repurchase strategically while large firms do not. Overall, our findings from the VAR analysis support the hypothesis that small firms repurchase to take advantage of superior information, while large firms repurchase regardless. This difference between small and large firms is evident in the relation between repurchase price and market price (*Diff*), in the frequency of repurchasing, and in the relation between repurchase and future returns.

5.3 Economic Significance of Abnormal Post-Repurchase Returns

To investigate the economic significance of the relation between actual repurchases and returns, we next form portfolios in which we buy firms that repurchase in the month and short firms that do not. We hold this position for various horizons. The portfolios are repurchase-value weighted using the variable *Rep/Size* for the firms that we buy, and equally weighted for the firms that we short.[27] We then measure the average cumulative *Alpha* and return relative to the base amount invested (which is equal to the amount shorted).

Table 9 reports the performance of various repurchase portfolios. Panel 9A reports cumulative *Alphas* and returns of portfolios constructed for different horizons. The first row of the panel reports the average cumulative *Alpha* for the entire sample. In this row, Column (1) reports the average 1-month *Alpha* of portfolios that buy firms that repurchased in the previous month and short firms that did not, and hold the portfolio for one month. Column (2) of this row reports the average cumulative 2-month return of portfolios that are constructed in the same manner but are held for two months. Cumulative average *Alpha*s for 3-month, 4-month, and 5-month portfolios are constructed in a similar manner and reported in Columns (3), (4), and (5), respectively. As the first row shows, the average 1-month portfolio *Alpha* is negative but insignificant. The cumulative *Alpha* is higher for the 2-month portfolio and peaks after three months, where it is positive at approximately 0.5% and significant at the 5% level. The average *Alpha*s of the 4-month and 5-month portfolios are positive but insignificant.

[27] We value-weight by repurchase volume because if repurchase is related to future return, we want to give more weight to larger repurchases.

The second and third rows in Panel 9A report the average cumulative *Alphas* of portfolios constructed based on the small-size third of the firms and the large-size third of the firms in our sample, respectively (results for the medium-sized portfolio are not reported). Here we implement the long-short strategy for each size group separately. The results show that the positive average *Alpha* reported for the entire sample actually originates in the smaller firms, and that the *Alpha*s for these firms are actually highest in the second month after the repurchase. The larger firms actually have negative but insignificant average *Alpha*s. The lower section of Panel 9A reports average cumulative returns (rather than *Alpha*s) in a similar manner. The results for the cumulative return are qualitatively similar to the results reported for *Alpha* in the upper section of the table. However, the results for the return are less significant. The average cumulative return on the 3-month portfolio of the small-firm group is significant only at the 10% level.

The results in Panel 9A indicate that the highest average *Alpha* and return are earned by the smaller firms in the second month following the repurchase. One possible explanation for the delay in the price response to actual repurchase is that while firms report repurchase activity on a monthly basis (in the financial report), this information becomes public only at the time of the quarterly reporting. The report is released three months after the repurchase on average, and hence the delay. We explore this possibility in Section 6.

Although we focus on the short term, we also constructed 12-month and 24-month portfolios (Columns (6) and (7), respectively) to compare our findings to earlier literature on long-run performance of repurchase-announcing firms, which finds positive and significant abnormal returns (e.g. Ikenberry et al. 1995, and Peyer and Vermaelen 2009).

As the table shows, average 12-month and 24-month *Alpha*s are insignificant for the entire sample and for the small-firm group and the large-firm group separately.[28] The difference between our findings and the findings in the above-mentioned literature on long-run abnormal returns may be due to the fact that we measure abnormal returns relative to actual repurchase while the literature considered above measures abnormal return relative to repurchase announcements. Alternatively, it is possible that our more recent sample accounts for this difference.

In Panel 9B we investigate the magnitude of the gain of a strategy that focuses on the small-firm group in the second month after the repurchase, as the results in Panel 9A suggest this strategy is likely to yield the greatest possible gain. Specifically, at the beginning of month t+2, we form a portfolio that buys all firms that had a repurchase in month t, and shorts all other firms. The portfolio is held for one month. For example, at the beginning of March 2004 we buy all firms that reported a repurchase in January 2004, and short all other firms, and hold this portfolio until the end of March 2004. At the end of the month the portfolio is sold. Each month a portfolio is constructed and the average *Alpha* and return of these portfolios are calculated and reported. Column (1) in Panel 9B shows this strategy earns an *Alpha* of 0.916% per month, or 12% annually, which is higher and more significant than any other strategy considered in Panel 9A. This result confirms that the highest return is indeed earned by investing in small-size firms in the second month after the repurchase. In Columns (2) and (3) we report the *Alpha* on the long position and the short position of the portfolio considered in Column (1), respectively. Column (4) in Panel 9B reports the average monthly return on this strategy,

[28] Naïve returns are positive and significant for the 24-month portfolio in the complete sample and for the small-firms group, but do not reflect abnormal performance.

which is also higher and more significant than the other monthly returns reported in Panel 9A. For completeness we also report the return on short and long positions in Columns (5) and (6) respectively. While the returns on the long and short portfolios are both positive, the return on the long portfolio is higher than the return on the short portfolio, consistent with our findings for *Alpha*.

Overall the results reported in Table 9 indicate that a repurchase-based portfolio does earn a positive and significant abnormal return. A portfolio that buys repurchasing S&P500 firms and is held for three months earns an *Alpha* of 0.5% or about 2% annually. These findings are consistent with the results of the regression analysis in Subsections 5.1 and 5.2 that the relation between repurchase and return is most significant in month 3 after the repurchase. Furthermore, a portfolio that focuses on smaller S&P500 firms can earn significantly higher returns (12% annually).

We acknowledge that because the monthly purchases are disclosed only in the financial report, the strategy is not feasible for uninformed investors. It, however, helps us assess the economic significance of the relation between actual repurchase and return. Given its significance, we next turn to investigating whether there is a significant market response when the information about actual repurchase is disclosed to the public.

6. Actual Repurchase and Earnings Announcements

While actual repurchase information is formally revealed in the financial reports, earnings announcements that precede the report generally already include disclosure of

actual repurchase activity during the report period.[29] We thus expect the market response to earnings announcements to reflect the information content of actual repurchase activity. For example, if firms repurchase in response to favorable information they have, we expect quarterly earnings announcements returns to be positively related to actual repurchases during the quarter.

Earlier studies have focused on the relation between repurchase program announcements and earnings announcements returns and provided inconclusive evidence.[30] Given that many repurchase plans are announced but not completed and the time lag between repurchase plan announcements and actual repurchases, we expect an investigation of the relation between actual repurchases and the earnings announcements of the same quarter to be more informative.

Table 10 reports our findings on this relation. In Panel 10A the dependent variable is the abnormal return (4-factor *Alpha*) on a 3-day window around the earnings announcement day. Q*rtRep* is the quarterly repurchase size calculated as the sum of the monthly repurchase. The variable *SUE* is a control variable for earning surprise and is calculated as the actual value of the earnings minus the average of the analysts' estimates in the month previous to the month of the announcement, divided by the standard deviation of the analysts' average estimate. The variable *PauseDum* is a dummy variable that controls for "surprise" in repurchase. It receives the value of 1 in the first quarter in

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[29] A check that we made of 50 quarters of randomly chosen firms in which there was actual repurchase showed that 47 of them reported their actual repurchase in the earning announcements.

[30] For example, Lie (2005) finds that the average earnings announcement return over eight quarters following the repurchase announcement is positive and significant only for firms with actual repurchase in the two quarters following the announcement. Gong, Louis and Sun (2008), however, find that this return is not different from the return on a control sample of firms that have similar accruals but do not announce a repurchase programs. Neither Lie (2005) nor Gong et al. (2008) consider the relation between actual repurchase in the quarter and the earnings announcement return of that quarter.

the sample in which a firm repurchased in and in every other quarter with positive repurchase that follows a pause in repurchase activity of at least one quarter for that firm. Regressions (1) and (2) report results for the complete sample. The coefficient of *QrtRep* is positive and significant at the 1% level both when it is the only explanatory independent variable (regression (1)) and when *SUE* is included as a control variable (regression (2)). The coefficient of *PauseDum* is insignificant.

Columns (3)-(4) and (5)-(6) report the results for the small-sized firms and large-sized firms, respectively. As the results show, repurchase is significant in explaining the earnings announcement return for the small firms but not for the large firms, suggesting that the actual repurchase data disclosed is informative only for small firms. Note that for large firms the *SUE* coefficient is still significant, suggesting the stock price of large firms is no less sensitive to information revealed in the announcement than that of small firms. It is only less sensitive to the repurchase information revealed. The coefficient of *PauseDum* is more than double for small firms relative to large firms and while not statistically significant, its *t*-statistic is relatively high.

For robustness, in Panel 10B the independent variable is the raw return (*Ret*) on the same 3-day window as in Panel 10A. As this panel shows the results for the 3-day window are qualitatively similar to the results for Alpha with the exception that the coefficient of *PauseDum* is significant at the 10% supporting the hypothesis that there is more information content in repurchase activity of small firms relative to large firms. Results were also qualitatively similar when we used a 1-day window instead of a 3-day window around the announcement as the dependent variable in both panels. We also repeated the analysis in Columns (3) through (6) for both panels using three groups of

MB (market-to-book, proxy for value firms vs. growth firms) instead of size (small vs. large). Here the repurchase coefficient was positive and significant only for growth firms (high MB). Consistent with our earlier findings, differences in the repurchase coefficient between MB groups were less significant than between size groups, suggesting that size is more important than MB in explaining repurchase activity.

Our interpretation of the findings in Table 10 is that small firms repurchase more the better their expectation of the firm's performance in the quarter. In particular, the positive and abnormal return on the earnings announcement day for small firms, documented in Table 10, is consistent with the delay in positive return on the repurchase for the small-firm portfolio reported in Panel 9A of Table 9. This is because earnings announcements are made on average one month after the quarter end, and as reported earlier, most repurchase activity happens in the second and third months of the fiscal quarter. Thus the market receives the repurchase information 1-2 months after the actual repurchase and the market response is delayed accordingly.[31]

To conclude, our analysis suggests that for small S&P 500 firms the market response to earnings announcements is positively related to repurchase data revealed in the earnings announcement but not for large S&P 500 firms. Our interpretation is that actual repurchases reveal mispricing for small S&P 500 firms but not for large ones.[32]

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[31] Indeed, when we split the 36 month returns of the portfolio in Panel 9B of Table 9 into two groups - announcement months (12 observations) and non-announcement months (24 observations), the average return in the announcement months is economically three times higher. This difference, however, was not statistically significant (*Pval* = 0.15), probably due to the small sample size.

[32] Furthermore, when we regressed earnings surprise on the quarter repurchase the relation was positive and significant only for the small firms, consistent with this interpretation.

7. Actual Repurchase and Insider Trades

If firms condition their actual repurchases on non-public information and market conditions, are actual repurchases also related to insider trading? This is the question considered in this section. There could be two possible reasons for such a relation. First, there could be a liquidity motivation; for example, when insiders sell their shares, they may want to use the repurchase to prevent downward pressure. Similarly when insiders buy, they may want the firm to refrain from repurchasing so as not to create an upward price pressure. Liquidity motivation will thus predict a negative correlation between actual repurchase and insider trading. Second, there could be an information motivation. That is, if insiders trade based on private information and execute repurchases based on this information, one would expect that when insiders buy, firms will repurchase more and when insiders sell, firms will tend to repurchase less. The information motivation will thus predict a positive correlation between actual repurchase and insider trade.

Table 11 reports our findings. Panel 11A reports the results of our analysis of monthly data. The dependent variable is insider trading in the open-market during the month calculated as net buy (buy minus sell) of shares of the insiders in the stock during the month dividend by the outstanding shares at the end of the previous month and presented in percentages. The Thompson Reuters data base defines four levels of insiders according to their relation to the firm. Level 1 insiders are insiders with the highest relation to the firm (e.g. CEO, and chairman). Level 4 insiders are insiders with the lowest relation to the firm (e.g. a retired shareholder, investment advisor, voting trustee). We run two sets of regressions. In the first set (regressions 1 through 4) the dependent variable is open-market insider trading of Level 1 insiders and in the second set

(regressions 5 through 8) the dependent variable is open-market insider trading of all-levels of insiders (Levels 1-4). For each month, insider trading is the net insiders' trade (buy less sell) normalized by the net outstanding shares at the end of the previous month.

The independent variable in all regressions is *Rep/Size* and we also control for *Alpha* (4-factor abnormal return) in all regressions. In regression (1) we report results for the complete sample and in regressions (2) through (4) we report the results for the different size-groups. The coefficient of the control variable *Alpha* is negative and significant consistent with earlier research indicating that insiders are generally contrarians (e.g. Cohen, Malloy, and Pomorski 2010).[33] As Panel 11A shows, the coefficient of *Rep/Size* is not significant in monthly data, either for the complete sample or for any of the size groups.

The results are different, however, when we consider the relation between repurchase and insider trading on a quarterly basis. In Panel 11B we aggregate the monthly insider and repurchase data over the quarter and repeat all the regressions in Panel 11A using the quarterly values. As Panel 11B shows the coefficient of *QrtRep* (quarterly repurchase aggregated from monthly repurchase) is positive and significant in all regressions.

The positive relation found between actual repurchases and insider trading on a quarterly basis thus supports the information motivation over the liquidity motivations. It suggests that insiders do not use repurchases to provide liquidity for their personal trade. Rather, when insiders believe the stock is undervalued, they repurchase and buy (or sell

[33] When we included lags of *Alpha* (we included up to three), the coefficients of these lags were also significant, consistent with insiders being contrarian investors. This inclusion however did not affect the qualitative results.

less) stock for their own portfolio; when they believe the stock is overvalued they repurchase less and buy less stock for their own portfolio (or sell more).

In fact, the finding of a relation between repurchases and insider trading only in the quarterly data but not in the monthly data further supports the information motivation over the liquidity motivation. This is because providing liquidity for insider trades through repurchase would require that repurchase and insider trading happen at the same time, while benefiting from information does not require a tight coordination as long as the information is not revealed too quickly. It is possible that information about mispricing motivates insiders to trade for their own portfolio and on the firm's behalf, but these trades are uncoordinated, and as a result a positive relation between repurchases and insider trading exists only in the quarterly analysis but not in the monthly analysis.

8. Conclusion

We use new data from SEC filings to investigate whether S&P 500 firms time their actual repurchase activity in the open market. We provide evidence suggesting that only the repurchase activity of small S&P 500 firms is associated with timing and with wealth transfers among investors. Specifically, we find that small S&P 500 firms repurchase less frequently than large firms and that only small S&P 500 firms repurchase at a price which is significantly lower than the average market price. Similarly actual repurchase activity is followed by a positive abnormal return only for small S&P 500 firms. This positive abnormal return (4-factor alpha) lasts for up to three months after the repurchase.

Our interpretation is that, because information asymmetry is high for small firms, they tend to repurchase strategically, whereas the repurchase activity of large firms is

more focused on disbursement of free cash. Consistent with this interpretation we find that the market responds positively to repurchase information revealed in earnings announcements only for small S&P 500 firms. We also find a positive correlation between actual repurchases and insider trading (net buys), suggesting that insiders repurchase and trade for their own portfolio based on information. Assuming monotonicity in the impact of firm size on repurchase activity, and given that firms outside the S&P 500 are smaller, we expect our findings for small S&P 500 firms to hold also for firms outside the S&P 500.

References

Allen, F., Michaely, R., 2003. Payout policy. In G. Constantinidies, M. Harris, and R. Stulz (Eds.), Handbook of the Economics of Finance, North-Holland, Amsterdam.,

Andriosopoulos, D., Hoque, H., 2011. Insider purchases talk and buybacks whisper. Working paper.

Babenko, I., 2009. Share repurchases and pay-performance sensitivity of employee compensation contracts. Journal of Finance 64, 117-150.

Babenko, I., Tserlukevich, Y., Vedrashko, A., 2011. The credibility of open market share repurchase signaling. Working paper.

Baker, M., Wurgler, J., 2002. Market timing and capital structure. Journal of Finance 57, 1-32.

Banyi, M., Dyl, E., Kahle, K., 2008. Errors in estimating share repurchases. Journal of Corporate Finance 14, 460-474.

Billet, M., Yu, M., 2011. Asymmetric information and open market share repurchases. Working paper.

Bonaime, A., 2010. Mandatory disclosure and firm behavior: Evidence from share repurchases. Working paper.

Bonaime, A., Ryngaert, M., 2010. Insider trading and share repurchases: Do insiders and firms trade in the same direction? Working paper.

Brav, A., Graham, J., Harvey, C., Michaely, R., 2005. Payout policy in the 21st century. Journal of Financial Economics 77, 483-527.

Brennan, M., T. Chordia, Subrahmanyam, A., 1998. Alternative factor specifications, security characteristics, and the cross-section of expected stock returns. Journal of Financial Economics 49, 345-373.

Brockman, P., Chung, D.Y., 2001. Managerial timing and corporate liquidity: Evidence from actual share repurchases. Journal of Financial Economics 61, 417-448.

Butler, A., Cornaggia, J., Grullon, G., Weston, J., 2011. Corporate financing decisions, managerial market timing, and real investment. Journal of Financial Economics 101, 666-683.

Butler, A., Grullon, G., Weston, J., 2005. Can managers forecast aggregate market returns? Journal of Finance 60, 963-985.

Carhart, M., 1997. On persistence in mutual fund performance. Journal of Finance 52, 57-82.

Chung, D., Isakov, D., Perignon, C., 2007. Repurchasing shares on a second trading line. Review of Finance 11, 253-2007.

Cohen, L., Malloy C., L. Pomorski, 2010. Decoding insider information. Working paper.

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., 2003. An analysis of SEC guidelines for executing open market repurchases. Journal of Business 76, 289-315.

Cook, D., Krigman, L., Leach, C., 2004. On the timing and execution of open market repurchases. Review of Financial Studies 17, 463-498.

Core, J., Guay, W., Richardson, S., Verdi, R., 2006. Stock market anomalies: what can we learn from repurchases and insider trading? Review of Accounting Studies 11, 46-70.

De Cesari, A., Espenlaub, S., Khurshed, A., Simkovic, M., 2009. Insider ownership, institutional ownership, and the timing of open market stock repurchases. SSRN working paper.

De Ridder, A., Rasbrant J., 2011. The market liquidity impact of share repurchase trading. SSRN Working Paper.

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

Dittmar, A., Dittmar, R., 2007, The timing of stock repurchases. SSRN working paper.

Dybvig, P., Zender, J., 1991, Capital structure and dividend irrelevance with asymmetric information. Review of Financial Studies 4, 201-219.

Fama, E., French, K., 1993. Common risk factors in the returns on stocks and bonds. Journal of Financial Economics 33, 3-56.

Ginglinger, E., Hamon, J., 2007. Actual share repurchases, timing and liquidity. Journal of Banking and Finance 31, 915-938.

Gong G., Louis H., A. Sun, 2008. Earnings Management and Firm Performance Following Open-Market Repurchases. Journal of Finance 63, 947-986.

Grullon, G., Michaely, R., 2002. Dividends, share repurchases, and the substitution hypothesis. Journal of Finance 57, 1649-1684.

Grullon, G., Michaely, R., 2004. The information content of share repurchase programs. Journal of Finance 59, 651-680.

Guay, W., Harford, J., 2000. The cash flow permanence and information content of dividend increases vs. repurchases. Journal of Financial Economics 57, 385-416.

Hamilton, J., 1994. Time Series Analysis. Princeton University Press, Princeton, New Jersey.

Henderson, B., Jagedeesh, H., Weisbach, M., 2006. World markets for raising new capital. Journal of Financial Economics 82, 63-101.

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

Ikenberry, D., Lakonishok, J., Vermaelen, T., 2000. Stock repurchases in Canada: Performance and strategic trading. Journal of Finance 55, 2373-2397.

Jagannathan, M. Stephens, C., 2003. Motives for multiple open-market repurchase programs. Financial Management 32, 71-91.

Kahle, K., 2002. When a buyback isn't a buyback: Open market repurchases and employee options. Journal of Financial Economics 63, 235-261.

Lie, E., 2005. Operating performance following open market share repurchase announcements. Journal of Accounting and Economics 39, 411-436.

McNally, W., Smith, B., 2010. A microstructure analysis of the liquidity impact of open market repurchases. Forthcoming in Journal of Financial Research.

McNally, W., Smith, B., Barnes, T., 2006. The price impacts of open market repurchase trades. Journal of Business Finance an Accounting 33, 735-752.

Newey, W., West, K., 1987. A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica 55, 703-708.

Oded, J., 2009. Optimal execution of open-market stock repurchase programs. Journal of Financial Markets 12, 832-869.

Petersen, M., 2009. Estimating standard errors in finance panel data sets: Comparing approaches. Review of Financial Studies 22, 435-480.

Peyer, U., Vermaelen, T., 2009. The nature and persistence of buyback anomalies. Review of Financial Studies 22(4), 1693-1746.

Pontiff, J., Woodgate, A., 2008. Share Issuance and Cross-Sectional Returns, Journal of Finance, 43, pp. 921-945.

Shumway, T., 1997. The delisting bias in CRSP data. Journal of Finance 52, 327-340.

Stephens, C., Weisbach, M., 1998. Actual share reacquisition 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.

Zhang, H., 2005. Share price performance following actual repurchases. Journal of Banking and Finance 29, 1887-1901.

Appendix A

This Appendix contains an example of a reporton an actual repurchase filed with the SEC. The reporting firm is Disney (Ticker: DIS) and the reporting is extracted from the 10Q report to the SEC for the period ending on June 30, 2007. The report date is August 1, 2007. The complete report is available at http://www.sec.gov/Archives/edgar/data/1001039/000119312507168199/d10q.htm

PART II. OTHER INFORMATION (continued)

ITEM 2. Unregistered Sales of Equity Securities and Use of Proceeds

The following table provides information about Company purchases of equity securities that are registered by the Company pursuant to Section 12 of the Exchange Act during the quarter ended June 30, 2007**:**

Period	Total Number of Shares Purchased [1]	Weighted Average Price Paid per Share	Total Number of Shares Purchased as Part of Publicly Announced Plans or Programs	Maximum Number of Shares that May Yet Be Purchased Under the Plans or Programs [2]
April 1, 2007 – April 30, 2007	24,856,354	34.80	24,755,700	86 million
May 1, 2007 – May 31, 2007	14,892,293	35.78	14,793,100	389 million
June 1, 2007 – June 30, 2007	16,108,541	34.44	15,985,800	374 million
Total	55,857,188	34.96	55,534,600	374 million

[1] 322,588 shares were purchased on the open market to provide shares to participants in the Walt Disney Investment Plan (WDIP) and Employee Stock Purchase Plan (ESPP). These purchases were not made pursuant to a publicly announced repurchase plan or program.

[2] Under a share repurchase program implemented effective June 10, 1998, the Company is authorized to repurchase shares of its common stock. On May 1, 2007, following share repurchases made through May 1, 2007, the Company's Board of Directors increased the repurchase authorization to a total of 400 million shares as of that date. The repurchase program does not have an expiration date.

Appendix B - Empirical Methodology

This Appendix includes a detailed description of the methods used in the paper. Section 1 describes the estimation of the covariance matrix in our panel data sample. Section 2 describes the estimation of the Tobit and Probit models including their marginal effects. Section 3 describes the estimation of the VAR (vector auto regression) models used in the paper, their impulse response functions, and the calculation of their confidence intervals.

1. Estimation of the Covariance Matrix

Our sample is a panel data set of 416 firms, with monthly observations over the years 2004–2006. For most of the firms we have 36 monthly observations. Several firms have less than 36 observations due to delisting issues. In the estimation of the covariance matrix of the parameters, we "cluster" by firm and add monthly time dummy variables. For further information about these methods see Petersen (2009).

We exploit the next M-L property to estimate the parameters' covariance matrix:

$$(\theta - \hat{\theta}) = \left(-\sum_{i=1}^{n}\sum_{t=1}^{T_i}\hat{\mathbf{H}}_{it}\right)^{-1}\left\{\sum_{i=1}^{n}\left(\sum_{t=1}^{T_i}\hat{\mathbf{g}}_{it}\right)\right\},$$

where H is the Hessian and g is the gradient.

The variance of the parameters, in all of the models in the paper (specifically: OLS, Probit and Tobit), is estimated by

$$\text{Est.Var}[\hat{\theta}] = [\text{Hessian}]^{-1}\text{Var}[\text{gradient}][\text{Hessian}]^{-1}$$

To take into account the autocorrelation in the firms' residuals, we sum the Hessians and the gradients by firm using

$$\mathbf{H} = \sum_{i=1}^{n}\sum_{t=1}^{T_i}\mathbf{H}_{it}$$
$$\mathbf{g} = \sum_{i=1}^{n}\sum_{t=1}^{T_i}\mathbf{g}_{it}$$

where H is the Hessian and g is the gradient of the specific model. Taking into account that the expectation of the gradient is zero at optimization, the variance of the gradient is estimated as

$$\left\{\sum_{i=1}^{n}\left(\sum_{t=1}^{T_i}\hat{\mathbf{g}}_{it}\right)\left(\sum_{t=1}^{T_i}\hat{\mathbf{g}}_{it}\right)'\right\}.$$

Upon substitution, the asymptotic variance of the parameters with firm cluster is

$$\text{Est.Var}[\hat{\theta}] = \left(-\sum_{i=1}^{n}\sum_{t=1}^{T_i}\hat{\mathbf{H}}_{it}\right)^{-1}\left\{\sum_{i=1}^{n}\left(\sum_{t=1}^{T_i}\hat{\mathbf{g}}_{it}\right)\left(\sum_{t=1}^{T_i}\hat{\mathbf{g}}_{it}\right)'\right\}\left(-\sum_{i=1}^{n}\sum_{t=1}^{T_i}\hat{\mathbf{H}}_{it}\right)^{-1}$$

2. Estimation of Tobit and Probit Models

2.1 Estimation of the Tobit Model

Step 1- Estimating the Model Parameters

We estimate the repurchase equation using the Tobit model (Tables 7 and 8). The Tobit model (also known as "the censored model") is used when the dependent variable is censored at some bound or bounds. The underlying assumption in this model is that there is a continuous variable behind the observed data and the econometrician does not see the "true" continuous variable in the censored area. In our repurchase data the bound is 0. In the months without repurchase we observe 0 and in months with repurchase we observe the repurchase (the underlying continuous variable).

In several estimations we use time and firm dummy variables as controls to capture the within-firm variability. In these cases we still cluster the residual by firm, using the procedure described in Item 1 of this Appendix. Clustering reduces the *t*-statistics of the parameters in our estimations.

Step 2 - Estimation of the Tobit Model Marginal Effects

After estimating the parameters, we estimate the marginal effects to estimate the effect of the explanatory variables on the dependent variable. For the Tobit model, the marginal effects are estimated at the mean of the explanatory variables by

$$MARGINAL = \frac{\partial \mathbf{E}[y \mid \bar{\mathbf{x}}]}{\partial \bar{\mathbf{x}}} = \Phi(\hat{\boldsymbol{\beta}}'\bar{\mathbf{x}} / \sigma) \times \hat{\boldsymbol{\beta}}$$

Because the marginal effects are a function of the estimated parameters, we estimate the variance of the marginal effects using the Delta method, which is a first-order Taylor expansion. The formula is

$$\left[\frac{\partial \mathrm{MRG}}{\partial \theta}\right]' \left[\mathrm{Est.Var}(\theta)\right] \left[\frac{\partial \mathrm{MRG}}{\partial \theta}\right]$$

where MRG are the marginal effects $\Phi(\hat{\boldsymbol{\beta}}'\bar{\mathbf{x}} / \sigma) \times \hat{\boldsymbol{\beta}}$.

2.2 Estimation of the Probit Model Parameters and Marginal Effects

After estimating the Tobit model, we proceed to estimate the probability for a repurchase using the Probit model (Table 7, Panel 7B). In the estimation of the Probit model, the dependent variable *Rep/Size*assumes the value of 1 in repurchase months and the value of 0 otherwise. As in the Tobit model, we use time and firm dummy variables as control variables in several cases, and cluster by firm.

The marginal effects of the Probit model are estimated at the mean of the explanatory variables by

$$MARGINAL = \frac{\partial \mathbf{E}[y \mid \bar{\mathbf{x}}]}{\partial \bar{\mathbf{x}}} = \left[\phi\left(\hat{\boldsymbol{\beta}}'\bar{\mathbf{x}}\right)\right]\hat{\boldsymbol{\beta}}$$

As in the Tobit model, the Delta method is used to estimate the variance of the marginal effect.

3. Estimation of the Impulse Response of the VAR (Vector-Auto-Regression) Models

3.1 The VAR Equations and Parameter Estimation

We estimate a bivariate VAR model. The dependent variables in the system are *Ret* and *Rep/Size*. In each equation of the system (one for *Ret* and one for *Rep/Size*) we include three lags of each dependent variable. The model equations are defined by the next system:

$$\begin{aligned} Rep/Size_t &= \alpha_1 + \sum_{i=1}^{3}\gamma_{1i} Rep/Size_{t-i} + \sum_{i=1}^{3}\beta_{1i} RET_{t-i} + \varepsilon_{1t} \\ RET_t &= \alpha_2 + \sum_{i=1}^{3}\gamma_{2i} Rep/Size_{t-i} + \sum_{i=1}^{3}\beta_{2i} RET_{t-i} + \varepsilon_{2t} \end{aligned} .$$

When constructing the VAR model, the contemporaneous relation between the dependent variables is basically in the covariance matrix of the residuals. Because contemporaneous causality cannot be inferred statistically, the econometricianmust decide which dependent variable “causes” the other. This decision is independent of which impulse response is investigated. Given the results in Table 7, that repurchase activity tends to follow a negative shock to return, and that the contemporaneous relation with the return is negative, we assumed that the return triggers the repurchase (although it is also possible that repurchases impact the return, which is also suggested by our results). For robustness we constructed the model under the opposite assumption that the repurchase rather than the return drives the results. The impulse responses resulting under this alternative assumption are qualitatively similar.

As discussed above, repurchase is a censored dependent variable. As using the OLS specification for the repurchase equation may yield inaccurate results, we estimate two versions of a bivariate VAR model. In the first version we estimate both *Ret* and *Rep/Size* in the OLS model. In this way we ignore the fact that *Rep/Size* is censored. In the second version*Ret* is estimated by the OLS model and *Rep/Size* is estimated by the Tobit model. We denote version one as OLS-VARand version two as Tobit-VAR. The results are qualitatively similar. For brevity the results of the OLS-VAR are not reported in this paper.

3.2 The Impulse Response Function Update

After estimating the models we estimate the impulse response function by sequentially updating the equations, based on the shocks to the system (a one-standard-deviation shock) and the estimated parameters. The shocks are given by the Cholesky decomposition of the residuals' covariance matrix. For the Tobit-VAR model we update the Tobit equation using $\partial y = \Phi(\hat{\beta}'\mathbf{X}/\sigma) \times \hat{\beta} \times \partial \mathbf{x}$ based on the information concerning the explanatory variable. If our model includes time and firm dummy variables, updating is performed without these dummy variables, because they are used exclusively as controls. In the updating procedure, the terms of the previous update are considered observed data rather than latent variables. Due to the nature of the repurchase variable, 0 or positive outcome, if the update outcome for *Rep*/*Size* is negative, it is set to 0. We did not encounter any such negative outcomes in the updates.

3.3 Confidence Intervals for the Impulse Response Function

The standard errors and confidence intervals of the impulse response are estimated by simulation (see Hamilton1994, pp. 336-337). We simulated 100,000 rounds. In each round we estimate the impulse response based on the draw of the new set of parameters. The draw is based on the estimated parameters and their covariance matrix.

To estimate the joint covariance matrix of the parameters from both equations of the VAR system, once again we use the M-L properties:

$(\theta - \hat{\theta}) = \left(-\sum_{i=1}^{n}\sum_{t=1}^{T_i}\hat{\mathbf{H}}_{it}\right)^{-1}\left\{\sum_{i=1}^{n}\left(\sum_{t=1}^{T_i}\hat{\mathbf{g}}_{it}\right)\right\}$, where H is the Hessian and g is the gradient.

The partition of the covariance matrix of the parameters from each equation K is given by

$$\text{Est.Var}[\hat{\theta}k] = \left(-\sum_{i=1}^{n}\sum_{t=1}^{T_i}\hat{\mathbf{H}}\mathbf{k}_{it}\right)^{-1}\left\{\sum_{i=1}^{n}\left(\sum_{t=1}^{T_i}\hat{\mathbf{g}}\mathbf{k}_{it}\right)\left(\sum_{t=1}^{T_i}\hat{\mathbf{g}}\mathbf{k}_{it}\right)'\right\}\left(-\sum_{i=1}^{n}\sum_{t=1}^{T_i}\hat{\mathbf{H}}\mathbf{k}_{it}\right)^{-1}$$

The partition of the covariance matrix of the parameters between equations 1 and 2 is given by

$$\text{Est.Covar}[\hat{\theta}1, \hat{\theta}2] = \left(-\sum_{i=1}^{n}\sum_{t=1}^{T_i}\hat{\mathbf{H}}\mathbf{1}_{it}\right)^{-1}\left\{\sum_{i=1}^{n}\left(\sum_{t=1}^{T_i}\hat{\mathbf{g}}\mathbf{1}_{it}\right)\left(\sum_{t=1}^{T_i}\hat{\mathbf{g}}\mathbf{2}_{it}\right)'\right\}\left(-\sum_{i=1}^{n}\sum_{t=1}^{T_i}\hat{\mathbf{H}}\mathbf{2}_{it}\right)^{-1}$$

.

These expressions allow us to estimate the entire covariance matrix of the equations' parameters even if one model is an OLS model and the second is a non-linear model such as the Tobit model.

In the OLS case (the usual VAR model) the estimation is straightforward and yields the familiar expression, $\Sigma \otimes (X' * X)^{-1}$, where Σ is the covariance matrix between the equations' residuals and X is the matrix of the explanatory variables.

3.4 Technical Note about the Covariance Matrix with Time and Firm Dummy Variables

As mentioned above, in order to estimate the confidence intervals of the impulse response function, we must draw a new set of parameters using the parameters' covariance matrix. When 450 dummy variables are included, such a draw is technically impossible. To circumvent this problem, after calculating the clustered covariance matrix, we make a draw from the partial covariance matrix, which is the partition of the covariance matrix that includes only the updated variable parameters.

Table 1: Sample Statistics of the 470 Firms in the Sample

Panel 1A reports the sample statistics of the complete sample of 470 firms. *Mean* is the average of the firm-level averages, *Median* is the median of the firm-level averages, and *Std.* is the standard deviation of the firm-level averages. *FirmSize*is the firm market capitalization, calculated as the outstanding shares multiplied by the CRSP price at the end of the previous month.*Dividend Yield* is the monthly dollar value of the firm's ordinary dividend (taken from CRSP) as a percentage of the firm's market capitalization in the previous month.*Ret* is the monthly stock return, and *Alpha* is the monthly abnormal return calculated using a four-factor model that is based on the three Fama-French (1993) factors and the Carhart (1997) momentum factor, and is calculated out of sample following Brennan et al. (1998).The variables *Ret* and *Alpha* areadjusted for delisting following Shumway (1997). *Market Volume*isthe monthly market dollar volume of trade in the stock, calculated as the sum over the month of the stock's daily market dollar volume. The daily market dollar volume, in turn, is calculated as the daily stock trade volume times the end-of-day price based on the CRSP data.
Panel 1B provides statistics of repurchasing vs. non-repurchasing firms. Columns (1)-(3) report statistics only for the 416 firms that reported repurchase transactions during the sample period 2004-2006, and Columns (4)-(6) report statistics for the remaining 54 firms that did not repurchase any shares during the sample period.

Panel 1A: Sample statistics– Complete sample

	470 firms (full sample)		
	(1)	**(2)**	**(3)**
	Mean	***Median***	***Std***
***Firm Size* (\$millions)**	22,268	10,745	38,939
***Dividend Yield* (monthly)**	0.13%	0.11%	0.12%
***Ret* (monthly)**	1.11%	1.09%	1.48%
***Alpha* (monthly)**	-0.18%	-0.06%	1.57%
***Market Volume* (\$millions)**	2,671	1,489	3,765

Panel 1BSample statistics – Repurchasing vs. non-Repurchasing firms

	416 firms with repurchase transaction			**54 firms with no repurchase transaction**			***Difference in means***	***t*-stat of difference in means**	**Wilcoxon of difference in means**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
	Mean	***Median***	***Std***	***Mean***	***Median***	***Std***			
***Size* (\$millions)**	23,543	11,747	39,899	12,159	5,943	29,005	11,384	2.52	4.58
***Dividend Yield* (monthly)**	0.14%	0.12%	0.12%	0.10%	0.03%	0.13%	0.04%	1.97	2.74
***Ret* (monthly)**	1.16%	1.11%	1.27%	0.66%	0.98%	2.56%	0.50%	1.43	1.22
***Alpha* (monthly)**	-0.08%	0.00%	1.34%	-0.95%	-0.56%	2.67%	0.87%	2.33	3.16
***Market Volume* (\$millions)**	2,753	1,555	3,749	2,053	967	3,865	700	1.31	3.18

Table 2–Statistics of Repurchase Activity for the 416 Repurchasing Firms

This table reports the statistics of the repurchase activity during the sample period, based on a total of 8,501 non-zeromonthly repurchase observations reported by the 416 firms that repurchased shares during the sample period. *Repurchase Volume* is the monthly dollar value repurchased, calculated as the monthly quantity of shares repurchased in the month multiplied by the monthly average repurchase price reported on the 10Q or 10K form. *Market Volume Given Repurchase* ismarket dollar volume of the trade in the stock in repurchase months calculated as the sum over the month of the stock's daily market dollar volume. (The monthly volume in Table 2 is different from the monthly volume reported in Table 1 because here we consider repurchase months only, whereas Table 1 includes all months regardless of repurchasing activity.) The daily market volume, in turn, is calculated as the daily stock trade volume times the end-of-day price based on the CRSP data. *Repurchase/Market Volume* is the repurchase dollar value as a percentage of the dollar volume of trade in the stock in the repurchase months. (This ratio is not Row 1 divided by Row 2 because the average of the ratio is not the ratio of the average).*Rep/Size* is the monthly dollar valueof the firm's repurchase as a percentage of the firm's market capitalization in the previous month.*Mean* is the average of the 8,501 observations, *Median* is the median of the 8,501 observations, and *Std.* is the standard deviation of the 8,501 observations.

	(1)	**(2)**	**(3)**
	Mean	***Median***	***Std***
***Repurchase Volume* ($millions)**	104	27	251
***Market Volume Given Repurchase* ($millions)**	3,244	1,725	4,604
Repurchase/Market Volume	3.3%	1.9%	4.6%
Rep/Size	0.41%	0.22%	0.64%

Table 3: Repurchasing Firms' Characteristics: Dependency on Firm Size

This table reports the repurchasing firms' characteristics and the dependency of these characteristics on firm size. We sort the 416 firms that had repurchase activity during the sample period into three equally sized groups by firm size. Firm sizeis the average market capitalization over the repurchase months for each firm, and market capitalization is calculated as the number of outstanding shares times the CRSP price at the end of the previous month. Starting with Panel 3A, *Firm Size Range* is the range of firm sizes in the group. The small-firm group includes firms with market capitalization in the range $0.5-$7.6 billion. The medium-sized firm group includes firms with market capitalization in the range $7.6-$18 billion, and the large-firm group includes firms with market capitalization in the range $18-$357 billion. Each of the reported variables is calculated equally weighted for each firm over monthly data, and then equally weighted over the firms in the group. *AverageSize* is the average firm market capitalization in each group in $ billion. *ReptoMktVol*is the average repurchase dollar value as a percentage of the dollar volume of trade in the stock in the repurchase months in each group. *HBAS* is the half bid-ask spread as a percentage, calculated in each repurchase month as the average of the daily closing bid and ask quotes from CRSP. *RetStd* is the standard deviation of the return, calculated for each month as the standard deviation of the daily returns within the month. *Number of Analysts* and *Dispersion of Analysts* are, respectively, the number of analysts covering the firm, and the dispersion of their quarterly earnings forecast, normalized by the forecast mean, and calculated based on monthly updates of forecasts from IBES. *MB* is market-to-book ratio, calculated following Grullon and Michaely (2002) as [(book value of assets + market value of equity –book value of equity) / book value of assets]. The sample here is smaller as five firms were eliminated because of negative market-to-book or missing components for the calculation of *MB*. Continuing in Panel 3B,*RepFreq* is the repurchase frequency measured as the ratio between the number of months in which the firm reported repurchase activity and the total number of months in which the firm appears in the sample. For example, if a firm has only 20 months of data in the sample period, and this firm repurchased in 10 out of these 20 months, the repurchase frequency is 50%. *Rep/Size* is the monthly dollar value of the firm's repurchases as a percentage of the firm's previous month market capitalization. *Dividend Yield* is the monthly dollar value of the firm's ordinary dividend (taken from CRSP) as a percentage of the firm's previous month market capitalization. *Total Payout Yield* is the sum of *Repurchase/Size* and *Dividend Yield*. *Repurchase Payout Ratio*is the average of the firm's annual dollar value of repurchase (calculated from monthly data) as a percentage of the firm's annual earnings (data item #18, Income before Extraordinary Items from Compustat). *Dividend Payout Ratio* and *Total Payout Ratio* are calculated similarly. With the exception of *ReptoMktVol* and *HBAS*(Panel 3A), which are calculated based on 8,501 repurchase months, all variables are calculated based on the complete sample of 14,669 observations (months with and without repurchase).

Panel 3A Firm characteristics: Dependency on firm size

Firm Size Group	# of Firms in Size Group	*Firm Size Range* (billions)	*Average Size* (billions)	*HBAS*	*Ret Std*	*Number of Analysts*	*Dispersion of Analysts*	*MB*
Small-Firm Group	139	$0.5-7.6	$4.5	0.046%	1.59%	11.80	0.16	1.58
Medium-Sized Firm Group	138	$7.6-18	$12.2	0.034%	1.42%	14.49	0.08	1.67
Large-Firm Group	139	$18-357	$54.9	0.028%	1.32%	19.06	0.08	1.67
All Firms	416	$0.5-357	$23.9	0.036%	1.44%	15.09	0.11	1.64
Difference Large less Small			50.3	-0.018%	-0.28%	7.26	-0.08	0.09
***t*-stat of difference**			10.26	7.37	4.85	9.34	2.00	0.74
Wilcoxon of difference			14.39	9.07	4.22	8.13	4.04	0.44

Panel 3B Payout characteristics: Dependency on firm size

Firm Size Group	# of Firms in Size Group	*Rep Freq*	*ReptoMktVol*	*Rep/Size*	*Dividend Yield*	*Total Payout Yield*	*Repurchase Payout Ratio*	*Dividend Payout Ratio*	*Total Payout Ratio*
Small-Firm Group	139	47%	3.7%	0.249%	0.122%	0.371%	0.52	0.18	0.70
Medium-Sized Firm Group	138	57%	3.0%	0.219%	0.142%	0.361%	0.49	0.33	0.82
Large-Firm Group	139	69%	3.3%	0.231%	0.148%	0.379%	0.50	0.30	0.80
All Firms	416	58%	3.3%	0.233%	0.137%	0.370%	0.50	0.27	0.77
Difference Large less Small		0.22	-0.37%	-0.018%	0.026%	0.008%	-0.03	0.12	0.09
***t*-stat of difference**		6.73	1.21	0.75	1.86	0.35	0.44	3.07	1.34
Wilcoxon of difference		6.37	0.65	0.32	2.68	0.42	0.55	3.57	1.46

Table 4 – Liquidity Statistics of Repurchasevs. Non-RepurchaseMonths

This table reports liquidity statistics of the sample of repurchase months vs. non-repurchase months. For each firm we calculate the average of the characteristic in the repurchase months and in the non-repurchase months and then calculate the difference. *HBAS* is the half bid-ask spread as a percentage, calculated in each month as the average of the daily closing bid and ask quotes from CRSP. *MktVol*is the average monthly dollar volume of trade in the stock on the market in millions of dollars. We include only firms with repurchase months and non-repurchase data; Of the sample of 416 firms, 394 firms had both repurchase months and non-repurchase months.

The table reports the averages of *HBAS* and *MktVol* for all months in Row (1), for repurchase months in Row (2), and for non-repurchase monthsin Row (3). The difference in the averages between repurchase months and non-repurchase months and the statistical significance of the differenceare also reported (calculated as a paired sample). The *p*-values and *t*-statistics are reported in Rows (5) and (6) of the table, respectively. Rows (7) to (10) report the results of a binomial test of the relation between repurchase and liquidity. For each of the variables, *HBAS* and *MktVol* we report the number of firms for which the difference between the average value of the variable in repurchase months less the average value of the variable in non-repurchase months is negative, and the number of firms for which this difference is positive. The statistical significance of the difference is confirmed with a binomial distribution test, assumingequal chances for positive and negative outcomes.

		HBAS	***MktVol***
(1)	**All Months**	0.0372	2667.8
(2)	**Repurchase Months**	0.0363	2710.0
(3)	**Non-Repurchase Months**	0.0380	2625.6
(4)	**Difference (3)-(2)**	-0.0016	84.4400
(5)	***p*-value of Difference (3)-(2)**	0.000	0.144
(6)	***t*-statistic of Difference (3)-(2)**	-3.65	1.46
(7)	**# Negative**	253 (64%)	159 (40%)
(8)	**#Positive**	141 (36%)	235 (60%)
(9)	**N**	394 (100%)	394(100%)
(10)	**Binomial Tests –*p*-value**	< 0.0001	< 0.0001

Table 5: The Difference between Repurchase Price and Market Price

This table reports averages and *t*-statistics of the *Diff* measure. This measure is defined as the average monthly price paid by the firm less the average monthly market price, divided by the average monthly market price(in %). The average monthly market price input for *Diff* is the value-weighted average of the CRSP end-of-day market price,weighted by the daily trade volume. The measure is winsorized around the 1% tails of its distribution.Panel 5A reports results for the different firm-size groups considered in Table 3.We partition the sample into equal-size groups by firm size:smallfirms, medium-sizedfirms, and largefirms. The first row of the table reports the *Diff* measure for the small-firm group. In Column (1),*Diff*average is the equally weighted average of the group's*Diff* averages, each firm's *Diff* averagebeing calculated equally weighted over the firm's monthly *Diff* observations.In Column (3),*Diff*average is the equally weighted average of thegroup's repurchase observationsof*Diff*. The next rows report the results for the medium-sized firm group and large-firm group in a similar manner. We thenreport the significance of the difference between small-firm group and thelarge-firm group.For completeness we also report the results for the complete sample(416 firms and 8,501 observations) at the bottom of the table. All *t*-statistics (in parentheses) are calculated based on clustering by firm and time, following Petersen (2009, Eq. 16).

Panel 5B repeats the analysis performed in Panel 5Aon groups formed based on MB instead of size. We partition the sample into equal-size groups by MB: low-MB firms, medium-MB firms, and high-MB firms. MB is calculated following Grullon and Michaely (2002) as [(book value of assets + market value of equity –book value of equity) / book value of assets]. The sample here is smaller as five firms were eliminated because of negative MB or missing components for the calculation of MB. In Column (3) the *t*-statistics are clustered by firm and time.

Panel 5A: Analysis of *Diff* by size groups

	***Diff*average based on 416 Firms' *Diff* averages**		***Diff*average based on 8,501 Repurchase Observations**	
	(1)	**(2)**	**(3)**	**(4)**
	***Diff* average**	**N**	***Diff* average**	**N**
Small-Firm Group	-0.416	139	-0.286	2,229
	[4.18]		[3.98]	
Medium-Sized Firm Group	-0.024	138	-0.05	2,762
	[0.38]		[0.93]	
Large-Firm Group	-0.010	139	-0.00	3,440
	[0.18]		[0.14]	
Small-Firm less Large-Firm Group: *t*-stat of *Diff*	-3.61		-3.25	
Small-Firms less Large-FirmGroup:Wilcoxon of *Diff*	-3.62		-4.85	
***Diff* of Complete Sample**	-0.149	416	-0.095	8,501
	[3.39]		[1.86]	

Panel 5B: Analysis of *Diff* by market-to-book groups

	***Diff* average based on 411 Firms' *Diff* averages**		***Diff* average based on 8,319 Repurchase Observations**	
	(1)	**(2)**	**(3)**	**(4)**
	***Diff* average**	**N**	***Diff* average**	**N**
Low-MBFirm Group (Value)	0.068	137	0.090	2,810
	[1.00]		[1.28]	
Medium-MB Firm Group	-0.284	137	-0.214	2,630
	[3.43]		[3.41]	
High-MB Firm Group (Growth)	-0.224	137	-0.156	2,879
	[2.92]		[2.07]	
Small-MB less High-MB Group: *t*-stat of *Diff*	2.84		2.95	
Small-MB less High-MB :Wilcoxon of *Diff*	3.25		5.09	
***Diff* of Complete Sample**	-0.147	411	-0.091	8,319
	[3.32]		[2.28]	

Table 6: Regression Analysis of the Difference between Repurchase Price and Market Price

This table reports the results of the panel regression of the *Diff* measure on different explanatory variables. The analysis is based on 8,501 non-zero repurchase observations.*Diff* is defined as the average monthly price paid by the firm less the average monthly market price, divided by the average monthly market price (in %). The average monthly market price input for *Diff* is the value-weighted average of the CRSP end-of-day market price, weighted by the daily trade volume. The measure is winsorized around the 1% tails of its distribution. *LnSize (t-1)* is the 1-month lag of *LnSize*where*LnSize*is the natural log of the firm's market capitalization, calculated as the outstanding number of shares times the CRSP price at the end of the previous month. *HBAS(t-1)* is the 1-month lag of *HBAS* where *HBAS* is the half bid-ask spread as a percentage, calculated in each month as the average of the daily closing bid and ask quotes from CRSP. *RepFreq* is the ratio between months with repurchase to total months that the firm appears in the sample.*LnMB*is the natural log of the firms market-to-book (MB) ratio, where MB is calculated following Grullon and Michaely (2002) as [(book value of assets + market value of equity –book value of equity) / book value of assets] using Compustat yearly data with Pontiff and Woodgate's(2008) approach for missing values.*RetStd(t-1)* is the 1-month lag of the standard deviation of the return, the standard deviation of the return being calculated for each month as the standard deviation of the daily returns within the month. *Rep/Size* is the ratio between the monthly repurchase dollar value and the firm's previous month's market capitalization. *ReptoMktVol* is the ratio between the monthly repurchase dollar value of trade in the stock and the monthly market dollar volume of trade in the stock.The regressions include time dummy variables and the *t*-statistics (in parentheses) arecalculated based on clustering by firm.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	-1.159	-1.569	-1.586	-2.243	-2.469	-2.404	-2.474
	[3.65]	[4.29]	[4.36]	[5.42]	[5.64]	[5.49]	[5.67]
LnSize(t-1)	0.098	0.123	0.097	0.084	0.099	0.096	0.101
	[3.56]	[4.12]	[3.04]	[2.80]	[3.07]	[3.00]	[3.17]
HBAS(t-1)		3.987	4.150		2.484	2.607	2.722
		[2.17]	[2.25]		[1.36]	[1.42]	[1.51]
RepFreq			0.347	0.299	0.310	0.299	0.312
			[2.36]	[2.01]	[2.09]	[2.01]	[2.09]
LnMB				-0.144	-0.138	-0.134	-0.135
				[3.84]	[3.66]	[3.48]	[3.51]
RetStd(t-1)						-0.032	-0.042
						[0.65]	[0.83]
ReptoSize							0.089
							[0.91]
ReptoMktvol							-0.571
							[0.49]
Adjusted - R^2	1.54%	1.65%	1.77%	2.01%	2.05%	2.04%	2.05%

Table 7: Determinants of Monthly Repurchases – Tobit and Probit Regression Results

This table reportsthe determinants of monthly repurchase activity using the Tobit and Probitmodels. The analysis is based on 14,669 observations (months with and without repurchases). Panel 7A presents the Tobit model results and Panel 7B presents the Probit model results. Both panels report the marginal effects of the estimation, estimated at the mean of the explanatory variables. The dependent variable is the monthly fraction of shares repurchased *Rep/Size*, measured as the ratio between the repurchase dollar value in month *t* and the previous month market capitalization. *Ret* is the return in month*t*adjusted for delisting, following Shumway (1997).*HBAS* is the half bid-ask spread as a percentage, calculated in each month as the average of the daily closing bid and ask quotes from CRSP. *HBAS(t-1)* is the 1-month lag of *HBAS*. Lags of the other variables are indicated in a similar manner. All regressions include time and firm dummy variables, and the *t*-statistics (in parentheses) areclustered by firm. See Appendix B for the estimation of the models' marginal effects and calculation of their *t*-statistics.

Panel 7A: Marginal effects of the Tobit model

	[2.63]		[2.77]						[3.28]	[3.57]
HBAS		-0.513	-0.538							-0.764
		[2.07]	[2.18]							[3.36]
HBAS(t-1)				-0.113		-0.117				
				[0.33]		[0.35]				
Rep/Size(t-1)					0.124	0.123	0.116	0.116	0.116	
					[6.64]	[6.72]	[6.65]	[6.65]	[6.66]	
Rep/Size(t-2)							0.014	0.014	0.014	
							[1.72]	[1.74]	[1.76]	
Rep/Size(t-3)							0.056	0.057	0.057	
							[4.45]	[4.49]	[4.44]	
Ret (t -1)					-0.004	-0.004	-0.004	-0.004	-0.004	
					[6.29]	[6.35]	[6.68]	[6.67]	[7.03]	
Ret(t-2)							-0.002	-0.002	-0.002	
							[4.20]	[4.34]	[4.74]	
Ret(t-3)							-0.001	-0.001	-0.001	
							[1.26]	[1.50]	[1.70]	

Panel 7B: Marginal effects of the Probit model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Ret	-0.003		-0.003						-0.003	-0.004
	[3.73]		[4.17]						[4.03]	[4.65]
HBAS		-1.032	-1.106							-1.354
		[2.73]	[2.87]							[3.51]
HBAS(t-1)				-0.821			-0.837			
				[2.20]			[2.27]			
Rep/Size(t-1)					0.161		0.160	0.153	0.153	0.152
					[5.66]		[5.79]	[5.73]	[5.73]	[5.83]
Rep/Size(t-2)								0.019	0.020	0.020
								[1.83]	[1.88]	[1.89]
Rep/Size(t-3)								0.082	0.083	0.083
								[4.90]	[4.97]	[4.94]
Ret (t -1)						-0.003	-0.003	-0.003	-0.003	-0.004
						[3.95]	[3.84]	[3.91]	[3.90]	[4.50]
Ret(t-2)								-0.002	-0.002	-0.002
								[2.54]	[2.71]	[3.14]
Ret(t-3)								0.000	0.000	-0.001
								[0.18]	[0.50]	[0.78]

Table 8: Impulse Responses of Repurchase and Return in Firm-Size Groups

This table reports VAR (vector auto regression) analysis results. The analysis is based on 14,669 observations (months with and without repurchases). Panel 8A reports the cumulative impulse response of repurchaseto a negative one-standard-deviation shock in return, controlling for firm size; Panel 8B reports the cumulative impulse response of return to a positive one-standard-deviation shock in repurchase, controlling for firm size. The repurchase variable considered in all models is *Rep/Size*, the ratio between the repurchase dollar value in month *t* and the previous month market capitalization. We use two different measures for return:*Alpha*, the monthly abnormal return, calculated using a four-factor model that is based on the three Fama-French (1993) factors and the Carhart (1997) momentum factor (calculated out of sample, following Brennan et al. 1998)and *Ret*, the return in month *t*.The variables*Alpha* and*Ret* areadjusted for delisting, following Shumway (1997). We sort all 416 firms into three equal-size groups, based on the firms' average market capitalization over the sample period:small firms, medium-sized firms, and large firms. For each size group we then estimate a Tobit-VAR model,i.e., a VAR model in which the return equation (*Ret*or, alternatively, *Alpha*) is estimated using an OLS model and the *Rep/Size* equation is estimated using a Tobit model. The models are estimated with three lags of *Rep/Size* and three lags of return (*Alpha* or,alternatively, *Ret*). We report the results only for the small-firm and large-firm groups. In Panel 8A, Columns (1) and (2) report the impulse response of *Rep/Size* to a negativeone-standard-deviation shock in *Alpha*for small firms and large firms, respectively, and Columns (3) and (4) report the impulse response of *Rep/Size* to a negativeone-standard-deviation shock in *Ret*for small firms and large firms, respectively. In Panel 8B, Columns (1) and (2) report the impulse response of *Alpha*to a positive one-standard-deviation positive shock in *Rep/Size* for small firms and large firms, respectively, and Columns (3) and (4) report the impulse response of *Ret*to a positiveone-standard-deviation shock in *Rep/Size* for small firms and large firms, respectively.All VAR models include time and firm dummy variables, and the *t*-statistics of the impulse response function are adjusted for clustering.The *t*-statistics are reported at the bottom of the panels, and are calculated using a simulation of 100,000 draws. A detailed description of the VAR models and the simulation used appears in Appendix B.

Panel 8A - Cumulativeresponse of *Rep/Size* to negative shocks in *Alpha* and *Ret*

	Rep/Size to Alpha		*Rep/Size to Ret*	
	(1)	(2)	(3)	(4)
Period	Small Firms	Large Firms	Small Firms	Large Firms
t	0.00%	0.00%	0.01%	0.00%
t+1	0.16%	0.12%	0.06%	0.02%
t+2	0.18%	0.16%	0.09%	0.03%
t+3	0.27%	0.22%	0.11%	0.03%
t+4	0.29%	0.25%	0.11%	0.03%
t+5	0.30%	0.25%	0.12%	0.03%
t+6	0.30%	0.26%	0.12%	0.03%
t+7	0.30%	0.26%	0.12%	0.03%
t+8	0.31%	0.27%	0.12%	0.03%
t+9	0.31%	0.27%	0.12%	0.03%
t+10	0.31%	0.27%	0.12%	0.03%
t+11	0.31%	0.27%	0.12%	0.03%
t+12	0.31%	0.27%	0.12%	0.03%
t+13	0.31%	0.27%	0.12%	0.03%
t+14	0.31%	0.27%	0.12%	0.03%
t+15	0.31%	0.27%	0.12%	0.03%
Response T0-T15	0.306%	0.266%	0.117%	0.033%
t-statistic *T0-T15*	2.78	4.80	4.09	2.57

Panel 8B - Cumulativeresponse of *Alpha*and *Ret*to a positive shock in *Rep/Size*

	Alpha to Rep/Size		*Ret to Rep/Size*	
Period	**(1) Small Firms**	**(2) Large Firms**	**(3) Small Firms**	**(4) Large Firms**
t	0.00%	0.00%	0.00%	0.00%
t+1	-0.05%	-0.15%	-0.02%	-0.14%
t+2	0.37%	-0.31%	0.39%	-0.25%
t+3	0.58%	-0.15%	0.65%	0.01%
t+4	0.59%	-0.13%	0.67%	0.05%
t+5	0.61%	-0.13%	0.68%	0.05%
t+6	0.62%	-0.13%	0.68%	0.06%
t+7	0.62%	-0.13%	0.69%	0.07%
t+8	0.62%	-0.13%	0.69%	0.07%
t+9	0.62%	-0.12%	0.69%	0.07%
t+10	0.62%	-0.12%	0.69%	0.07%
t+11	0.62%	-0.12%	0.69%	0.07%
t+12	0.62%	-0.12%	0.69%	0.07%
t+13	0.62%	-0.12%	0.69%	0.07%
t+14	0.62%	-0.12%	0.69%	0.07%
t+15	0.62%	-0.12%	0.69%	0.07%
Response T0-T15	0.624%	-0.124%	0.693%	0.075%
t-statistic *T0-T15*	2.07	-0.63	2.45	0.38

Table 9: Alphas and Returns Based on Repurchase Portfolio

This table reports the average *Alpha*and return on portfolios that are long repurchasing firms and short non-repurchasing firms. Every month we construct a portfolio in which we buy all firms that repurchased in the previous month and short all firms that did not, and hold the position for different horizons. The portfolios are repurchasevalueweighed using the variable *Rep/Size* (measured as the ratio between the reported monthly repurchase volume in month *t* and the market value of the firm at the end of month *t-1*, calculated using CPSP) for the firms that we buy, and equally weighted for the firms that we short.*Alpha* is the monthly abnormal return,calculated using a four-factor model that is based on the three Fama-French (1993) factors and the Carhart (1997) momentum factor, and where *Alpha*is calculated as out-of-sample alpha, following Brennan et al. (1998).Return is the return in month *t*.Returnand *Alpha* areadjusted for delisting, following Shumway (1997). Panel 9A reports the average cumulative *Alpha*and return of portfolios formed for different horizons. The first row in Panel 9A reports average cumulative *Alphas*. In this row, Column (1) reports the average *Alpha*of 1-month portfolios, i.e., the average monthly *Alpha*when each portfolio is constructed at the beginning of the month and sold at the end of the month. For example, at the beginning of February 2004 we buy all firms that reported a repurchase in January 2004, and short all other firms, and hold this portfolio until the end of February 2004. Column (2) reports the average 2-month *Alphas*of portfolios that are constructed each month and held for two months. For example, at the beginning of February 2004 we buy all firms that reported a repurchase in January 2004, and short all other firms, and hold this portfolio until the end of April 2004. Columns (3) to (7) are constructed in the same manner for horizons of 3,4,5,12 and 24 months. We then partition the firms into three equal-size groups according to their average sizeover the sample period. The second and third rows in Panel 9A report the average cumulative *Alphas*for the small firms and the large firms, respectively (results for the medium-sized firms are not reported). The next part of Panel 9A reports average cumulative returns in a similar manner. The *t*-statistics in Panel 9A are in parentheses andare corrected for serial correlation in the residuals followingNewey-West (1987).Panel 9B reports the average *Alpha*and return of the small-firm group (139 firms) in the sample, for portfolios that are constructed as follows. At the beginning of *t*+2we buy all firms that had a repurchase during the month *t*, and short all other firms. The portfolio is held for one month and then sold. Each month a portfolio is constructed and the panel reports the average *Alpha*and return of these portfolios. For example, at the beginning of March 2004 we buy all firms that reported a repurchase in January 2004, and short all other firms, and hold this portfolio until the end of March 2004. Column (1) of Panel 9B reports the average *Alpha*of these portfolios while Columns (2) and (3) reports the breakdown of *Alpha* on the long and short positions, respectively. Columns(4)–(6) report the results forthe average return.

Panel 9A – Cumulative *Alpha* and return of repurchase portfolios

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	N
Time period	***t*+1**	**t+1 to t+2**	**t+1 to t+3**	**t+1 to t+4**	**t+1 to t+5**	**t+1 to t+12**	**t+1 to t+24**	
Average Cumulative Alpha								
All Firms	-0.139	0.133	0.481	0.408	0.466	0.371	-0.427	416
	[0.89]	[0.64]	[1.92]	[1.14]	[1.26]	[0.45]	[0.63]	
Small-Firm Group	0.211	1.063	1.402	1.651	1.645	2.047	0.480	139
	[0.84]	[3.01]	[3.57]	[3.44]	[2.77]	[1.01]	[0.28]	
Large-Firm Group	-0.279	-0.479	-0.268	-0.817	-0.832	-0.858	-1.891	139
	[1.14]	[1.16]	[0.47]	[1.03]	[0.85]	[0.40]	[1.03]	
Average Cumulative Return								
All Firms	-0.115	0.085	0.405	0.286	0.329	0.108	-1.899	416
	[0.64]	[0.40]	[1.62]	[0.83]	[0.80]	[0.17]	[2.11]	
Small-Firm Group	0.078	0.716	0.922	1.112	1.062	1.177	-2.008	139
	[0.26]	[1.77]	[1.84]	[1.77]	[1.33]	[0.73]	[2.22]	
Large-Firm Group	-0.230	-0.421	-0.213	-0.894	-0.982	-1.222	-3.982	139
	[0.97]	[1.01]	[0.36]	[1.07]	[0.94]	[0.45]	[1.24]	

Panel 9B –*Alpha* and return of a 1-month repurchase portfolio using astrategy of a 2-month-lag investment in the small-firm

	Alpha			Return		
	(1)	(2)	(3)	(4)	(5)	(6)
	Strategy	L	S	Strategy	L	S
Time Period	***t*+2**	***t*+2**	***t*+2**	***t*+2**	***t*+2**	***t*+2**
Small Firms Average	0.916	0.346	-0.570	0.725	1.577	0.852
	[2.84]	[1.05]	[2.47]	[1.98]	[2.94]	[1.35]

Table 10: Market Response to Earnings Announcementsand Actual Repurchase

This table reports regression results of earnings announcements abnormalreturnon actual repurchase.In Panel 10A the dependent variable is the abnormal return(4-factor *Alpha*) on a 3-day window around the earnings announcement from day -1 to day +1. If the time of the earnings announcement is before 15:45 (71% of the sample) we use the current day as the day of the announcement. Otherwise we use the following business day as the day of the announcement, where return is measured using close prices. Columns (1) and (2) report results for the complete sample while Columns (3) and (4), and (5) and (6), report the results for the small firms and large firms, respectively (results for the medium-sized firms are not shown). Q*rtRep* is the quarterly repurchase size, estimated as the monthly dollar value of the firm's repurchase as a percentage of the firm's market capitalization in the previous month, and aggregated over the months in the quarter.*SUE* is a measure of earning surprise calculated as the actual value of the earnings minus the average of the analysts' estimates in the month previous to the month of the announcement, divided by the standard deviation of the analysts' average estimate.*PauseDum* is a dummy variable that receives the value of 1 in the first quarter in the sample in which a firm repurchased and in every other quarter with positive repurchase that follows a pause in repurchase activity of at least one quarter for that firm.In Panel 10B the dependent variable is the naïve return (*Ret*) on a 3-day window around the earning announcement day where the day of announcement is determined as in Panel 10A. All regressions include time and firm dummy variables, and the *t*-statistics (in parentheses) are clustered by firm.

Panel 10A: 3-day *Alpha*

	All Firms		Small Firms		Large Firms	
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-5.245	-6.574	-13.811	-11.670	-4.141	-4.205
	[2.13]	[2,64]	[4.08]	[4.35]	[1.26]	[1.42]
QrtRep	0.350	0.334	0.420	0.415	0.127	0.122
	[3.55]	[3.35]	[2.52]	[2.47]	[0.57]	[0.55]
SUE		0.278		0.252		0.348
		[5.19]		[2.13]		[5.59]
PauseDum		0.288		0.820		0.365
		[1.19]		[1.46]		[0.88]
N	4406	4406	1463	1463	1495	1495
Adjusted - R^2	1.36%	5.32%	4.73%	6.50%	1.17%	6.67%

Panel 10B: 3-day *Ret*

	All Firms		Small Firms		Large Firms	
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-7.277	-8.501	-11.871	-10.436	-3.432	-3.608
	[2.90]	[3.41]	[3.60]	[3.74]	[1.07]	[1.24]
QrtRep	0.342	0.329	0.409	0.402	0.161	0.159
	[3.51]	[3.36]	[2.48]	[2.43]	[0.73]	[0.72]
SUE		0.272		0.240		0.333
		[5.16]		[2.07]		[5.31]
PauseDum		0.351		0.951		0.453
		[1.47]		[1.73]		[1.08]
N	4406	4406	1463	1463	1495	1495
Adjusted - R^2	6.15%	9.75%	10.03%	11.22%	5.64%	10.39%

Table 11: Actual Repurchase and Insider Trading

This table reports regression results of insider trading on actual repurchase. The analysis in is based on 14,669 observations (months with and without repurchases). Panel 11A reports results on a monthly basis. The dependent variable is the net insider trading during the month, calculated as net buy (buy minus sell) of shares of the insiders in the stock during the month divided by the outstanding shares at the end of the previous month and presented in percentage. *Rep/Size* is monthly dollar value of the firm's repurchase in the month as a percentage of the firm's market capitalization at the end of the previous month. *Alpha* is monthly abnormal return, calculated using a four-factor model, that is based on the three Fama-French (1993) factors and the Carhart (1997) momentum factor (calculated out of sample, following Brennan et al. 1998). In regressions (1) through (4) insiders are Level 1 insiders,i.e. insiders with the highest relation to the firm, as defined by Thompson Reuters.

Regression (1) reports the regression results for the complete sample, while regressions (2) through (4) reports the results for the subsamples of small, medium and large firms, respectively. In regressions (5) through (8) we repeat the analysis in regressions (1) through (4) using insiders of all levels (Level 1 through 4 as defined by Thompson Reuters).

Panel 11B repeats the analysis on a quarterly basis. The independent variable is quarterly insider trading estimated as the aggregate of monthly insider trading, where monthly insider trading is calculated as in Panel 11A. Q*rtRep* is the quarterly repurchase size, estimated as the aggregate of monthly repurchase where monthly repurchase is calculated as in Panel 11A. *QrtAlpha* is abnormal return in the quarter estimated similarly using monthly *Alpha*. All regressions in Table 11 include time and firm dummy variables, and the *t*-statistics (in parentheses) are clustered by firm.

Panel 11A: Monthly data

	Level 1 - Direct			All Levels - Direct and Indirect		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Small Firms	Large Firms	All	Small Firms	Large Firms
Intercept	-4.701	0.120	-3.574	-8.504	-3.423	-8.310
	[7.16]	[0.12]	[2.73]	[9.16]	[2.16]	[6.46]
Rep/Size	-0.239	-0.129	-0.178	-0.410	-0.174	0.623
	[1.04]	[0.49]	[0.28]	[1.08]	[0.34]	[0.82]
Alpha	-0.078	-0.057	-0.103	-0.229	-0.165	-0.308
	[4.85]	[2.73]	[3.59]	[7.62]	[3.51]	[5.78]
N	14669	4864	4940	14669	4864	4940
Adjusted - R^2	4.85%	14.00%	20.36%	17.24%	13.52%	24.36%

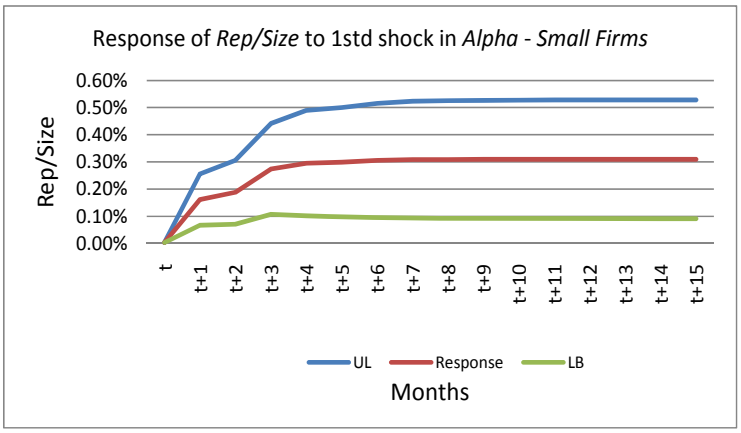
Panel 11B: Quarterly data

	Level 1 - Direct			All Levels - Direct and Indirect		
	(1)	(2)	(4)	(5)	(6)	(8)
	All	Small Firms	Large Firms	All	Small Firms	Large Firms
Intercept	-26.750	-12.927	-3.446	-35.850	-43.167	-34.930
	[13.78]	[2.41]	[1.32]	[13.17]	[5.78]	[9.82]
QrtRep	1.200	1.218	2.310	1.970	3.471	3.068
	[2.44]	[1.80]	[1.76]	[2.49]	[2.69]	[2.17]
QrtAlpha	-0.284	-0.296	-0.206	-0.687	-0.721	-0.685
	[5.74]	[3.84]	[2.51]	[8.65]	[5.21]	[6.51]
N	4881	1619	1645	4881	1619	1645
Adjusted - R^2	24.86%	19.94%	42.69%	27.58%	20.67%	40.72%

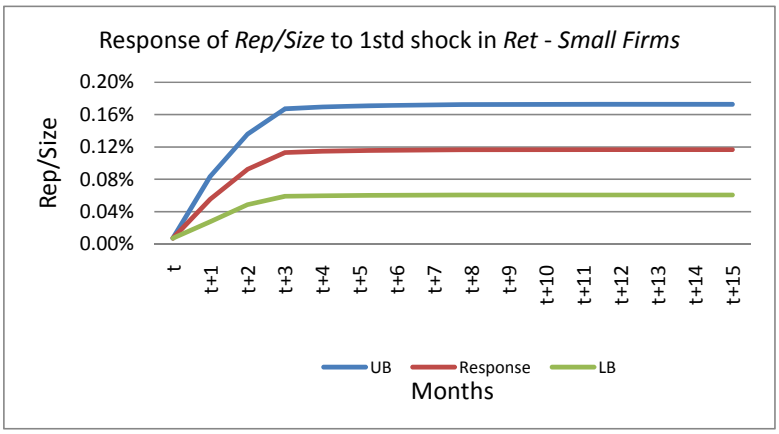
Figure 1: Impulse Response of Repurchase to a Negative Shock in Return - Small Firms vs. Large Firms

This figure depicts the impulse response of repurchase to a negative shock in return, for the small firms and large firms in our sample, using a Tobit-VAR model, as reported in Panel 8A of Table 8. We sort the firms in the sample into three equally-sized groups by firm size. We present the impulse responses only for the small-firm and the large-firm groups. The variable we use for repurchase is *Rep/Size*, repurchase in month *t* normalized by firm size in month *t*-1. We use two measures of return. The first measure is *Alpha*, the monthly abnormal return in month *t*, calculated using a 4-factor model that is based on the three Fama-French factors and the Carhart (1997) momentum factor. *Alpha* is calculated out of sample following Brennan et al. (1998). The second measure we use is *Ret*, the naïve return in month *t*. The variables *Alpha* and *Ret* are adjusted for delisting following Shumway (1997). Graphs 1A and 1B depict the impulse response of *Rep/Size* to a negative one-standard-deviation shock in *Alpha*, for small firms and large firms, respectively. Graphs 1C and 1D depict the impulse response of *Rep/Size* to a negative one-standard-deviation shock in *Ret*, for small firms and large firms, respectively. In all graphs, the middle line represents the impulse response, and the upper and lower lines represent 5% confidence intervals, calculated using a simulation of 100,000 draws (see Hamilton 1994, pp. 336-337), adjusted for clustering. The models are estimated using three lags of *Rep/Size* and three lags of return (*Alpha* or, alternatively, *Ret),* and time and firm dummy variables. A detailed description of the VAR model estimation and the impulse response calculation appears in Appendix B.

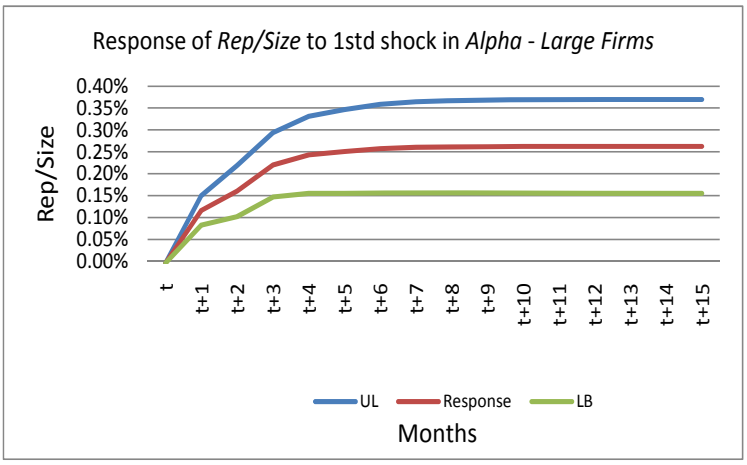
1A



1C



1B **1D**


Response of *Rep/Size* to 1std shock in *Alpha - Large Firms*
Rep/Size
0.40%
0.35%
0.30%
0.25%
0.20%
0.15%
0.10%
0.05%
0.00%
t
t+1
t+2
t+3
t+4
t+5
t+6
t+7
t+8
t+9
t+10
t+11
t+12
t+13
t+14
t+15
UL
Response
LB
Months

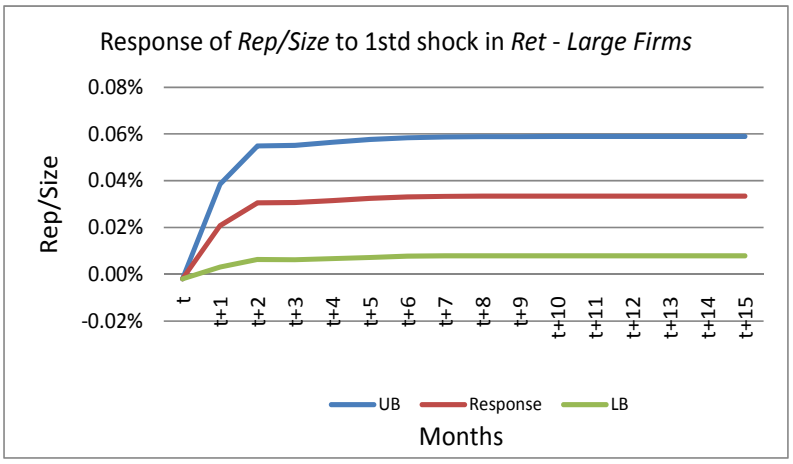
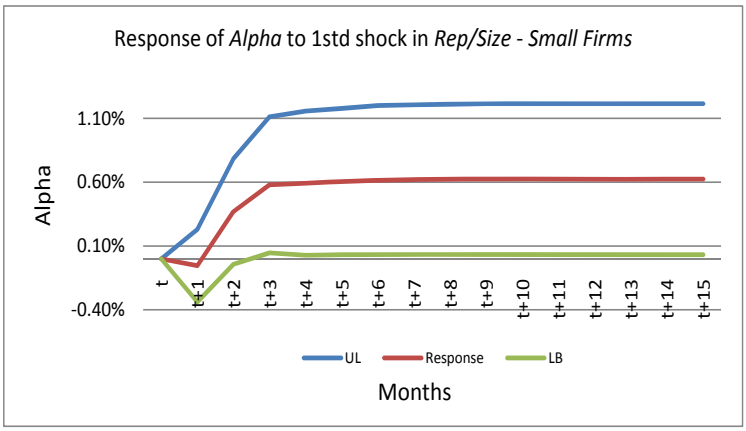

Response of *Rep/Size* to 1std shock in *Ret - Large Firms*
Rep/Size
0.08%
0.06%
0.04%
0.02%
0.00%
-0.02%
t
t+1
t+2
t+3
t+4
t+5
t+6
t+7
t+8
t+9
t+10
t+11
t+12
t+13
t+14
t+15
UB
Response
LB
Months

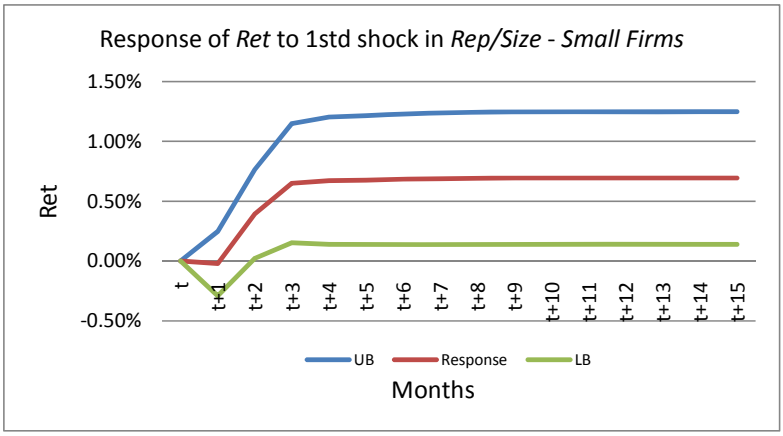
Figure 2: Impulse Response of Stock Return to a Positive Shock in Repurchase - Small Firms vs. Large Firms

This figure depicts the impulse response of return to a positive shock in repurchase, for the small firms and large firms in our sample, using a Tobit-VAR model, as reported in Panel 8B of Table 8. We sort the firms in the sample into three equally-sized groups by firm size. We present the impulse responses only for the small-firm and the large-firm groups. We use two measures of return. The first measure is *Alpha*, the monthly abnormal return in month *t*, calculated using a 4-factor model that is based on the three Fama-French factors and the Carhart (1997) momentum factor. *Alpha* is calculated out of sample following Brennan et al. (1998).The second measure we use is *Ret*, the naïve return in month *t*. The variable we use for repurchase is *Rep/Size*, repurchase in month *t* normalized by firm size in month *t*-1. The variables *Alpha* and *Ret* are adjusted for delisting following Shumway (1997). Graphs 2A and 2B depict the impulse response of *Alpha* to a positive one-standard-deviation shock in *Rep/Size*, for small firms and large firms, respectively. Graphs 2C and 2D depict the impulse response of *Ret* to a positive one-standard-deviation-shock in *Rep/Size*, for small firms and large firms, respectively. In all graphs, the middle line represents the impulse response, and the upper and lower lines represent 5% confidence intervals, calculated using a simulation of 100,000 draws (see Hamilton, 1994, pp. 336-337), adjusted for clustering. The models are estimated using three lags of *Rep/Size* and three lags of return (*Alpha* or, alternatively, *Ret)*, and time and firm dummy variables. A detailed description of the VAR model estimation and the impulse response calculation appears in Appendix B.

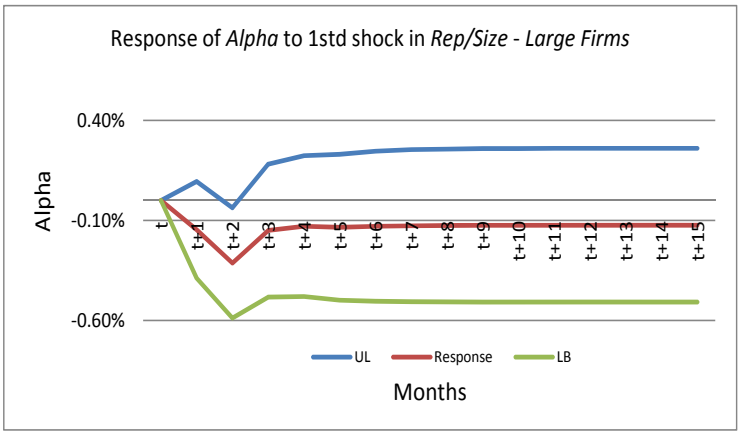
2A

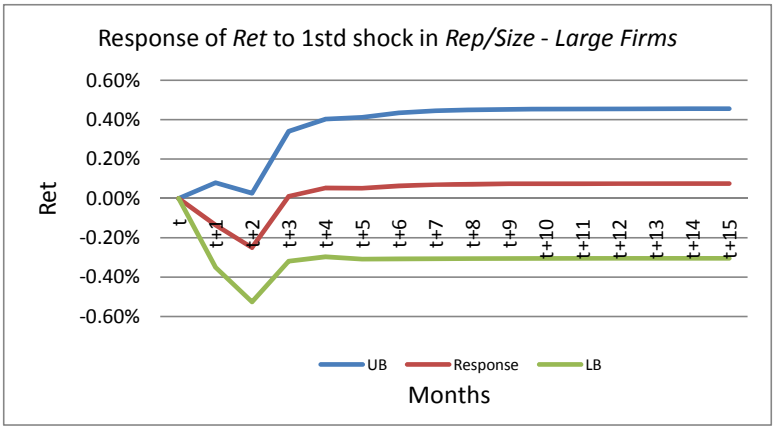


2C



2B **2D**


Response of *Alpha* to 1std shock in *Rep/Size - Large Firms*
0.40%
-0.10%
-0.60%
Alpha
t
t+1
t+2
t+3
t+4
t+5
t+6
t+7
t+8
t+9
t+10
t+11
t+12
t+13
t+14
t+15
UL
Response
LB
Months


Response of *Ret* to 1std shock in *Rep/Size - Large Firms*
0.60%
0.40%
0.20%
0.00%
-0.20%
-0.40%
-0.60%
Ret
t
t+1
t+2
t+3
t+4
t+5
t+6
t+7
t+8
t+9
t+10
t+11
t+12
t+13
t+14
t+15
UB
Response
LB
Months