

Do Firms Buy Their Stock at Bargain Prices? Evidence from Actual Stock Repurchase Disclosures*

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Abstract. Using new monthly data, we investigate open-market repurchase executions of US firms. We find that firms repurchase at prices that are significantly lower than average market prices. This price discount is negatively related to size and positively related to market-to-book ratio. Firms' repurchase activity is followed by a positive and significant abnormal return. Importantly, the market response occurs when firms disclose their actual repurchase data in earnings announcements, and this positive response is followed by a 1-month drift. Consistent with these results, we find that insider trading is positively related to actual repurchases.

JEL Classification: G14, G30, G35

1. Introduction

The question whether firms time their repurchases is important as such timing may result in wealth transfers among investors. Indeed, Brav *et al.* (2005) survey corporate executives and find that 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

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repurchases. In fact, it may take the firm several years to complete a program, if it completes the program at all (see Stephens and Weisbach, 1998).

Although stock repurchases have become an economically significant payout tool in the USA, 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 nonmarket 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 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 article, we explore this new data source. We hand-collect information about actual repurchases of a sample of 620 firms from their 10Q and 10K filings for the years from 2004 to 2009. The data include information regarding the monthly number of shares repurchased and the average monthly repurchase price. In particular, we are interested in learning: (i) whether firms purchase their shares at discounted prices relative to prices paid by other investors during the repurchase month; (ii) whether actual repurchase activity is followed by positive abnormal returns; (iii) whether the market response to actual repurchase data information released is consistent with market timing; and (iv) whether actual repurchases relate to insider trading in a manner indicating market timing.

We find clear evidence that firms purchase their shares at discounted prices relative to prices paid by other investors. Furthermore, this discount is positively related to market-to-book (MB) and negatively related to size, suggesting that small firms and growth firms repurchase their shares at lower prices compared to large and value firms. To demonstrate the economic magnitude of the discount, we sort our sample into nine groups by

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 Banyl, 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.

independent sorts by size and MB, and show that the highest discount is attained for the small growth group. The average monthly price that firms in this group pay for their stock is 1.105% below the average monthly market price, and the difference is statistically significant at the 1% level. This discount decreases when moving among the groups toward larger size and higher value.

Small firms repurchase less frequently than large firms. Specifically, when we sort our sample into three equal-size groups, we find that small firms repurchased in 22% of the reported months whereas large firms repurchased in 48% of the months. This may suggest that small firms' repurchasing at discounted prices is related to repurchasing strategically. Indeed, in regression analysis, we find that the price discount is negatively related to repurchase frequency. We find no difference in repurchase frequency between value and growth firms when sorting similarly by MB. However, we find that the ratio of repurchase to total payout (dividends plus repurchase) is significantly lower for value firms relative to growth firms. Specifically, repurchases account for about 55% of total payout for value firms and for about 85% of total payout for growth firms. This, in turn, may suggest that value firms are less focused on timing the market in the first place. Indeed, in our regression analysis, we find that repurchasing at discounted prices is positively related to the repurchase-to-payout ratio.

Repurchasing at lower prices is also related to liquidity. 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.

Consistent with earlier investigations of quarterly repurchase data that find repurchases tend to follow price drops (see literature review in Section 2), we show that monthly repurchase activity is negatively related to past and contemporaneous returns. An important question, however, is whether actual repurchases are related to future returns. We find that actual repurchase activity is followed by a positive and significant abnormal return. Importantly, this return is related to disclosure of actual repurchase activity in earnings announcements. Specifically, while firms are required to report actual repurchases only in the financial statements, they generally disclose their repurchase activity during the quarter with their earnings announcement (several days before filing their quarterly report). In our tests, we consider three periods around earnings announcements: preannouncement, announcement, and postannouncement, and investigate the relation between the quarterly repurchase and the 4-factor alpha in these periods. We find no relation at the preannouncement period. However, we do find a positive and

significant relation during the announcement period, followed by a 1-month significant drift. To demonstrate the economic magnitude, we show that a portfolio based on actual repurchase data and constructed around the earnings announcement earns an abnormal return of about 5.1% annually, which is significant at the 1% level.

We acknowledge that our findings do not necessarily imply that firms repurchase to benefit from underpricing. It is possible that the 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 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 insider trading is positively related to actual repurchases during the pre-earnings announcement period.

Overall, our findings suggest that firms are able to repurchase their stock at discounted prices relative to the market price, and that this discount is negatively related to size and positively related to MB (growth opportunities). In addition, the market responds positively to repurchase data revealed in earnings announcements, and insider trading (net buys) is positively related to actual repurchases during the pre-earnings announcement period. For robustness, we have verified that these main results hold in the subperiods 2004–06 and 2007–09, separately.

The informational effects of actual repurchase that we find suggest that regulators should consider even tighter disclosure requirements (e.g., reporting actual repurchases to the SEC in a more timely manner). We expect such requirements to result in more informative prices and to alleviate wealth expropriations from uninformed investors.

The remainder of this article is organized as follows. Section 2 reviews related literature. Section 3 describes the data and the methodology. Section 4 provides sample statistics and examines how actual repurchases

are related to firm characteristics. Section 5 examines the manner in which actual repurchases are related to past returns and liquidity. Section 6 analyzes the repurchase discount, namely, relation between repurchase price and market price. Section 7 investigates the relation between actual repurchases and returns around earnings announcements, and Section 8 investigates the relation between actual repurchases and insider trading. Section 9 concludes.

2. Literature Review

The general question of whether firms time their financial decisions has received considerable attention in the financial literature.⁴ The most closely related studies include Ikenberry, Lakonishok, and Vermaelen (2000), Brockman and Chung (2001), Cook, Krigman, and Leach (2004) (henceforth, CKL, 2004), McNally, Smith, and Barnes (2006), Ginglinger and Hamon (2007), and De Cesari *et al.* (2012).

CKL (2004) investigate actual repurchases in the USA before the regulation amendment using repurchase data disclosed voluntarily by sixty-four firms during a 1-year period ending March 1994. With respect to repurchasing at discounted prices, they find that NYSE firms pay less than representative daily prices, whereas NASDAQ firms pay more. Using postregulation change US repurchase data, De Cesari *et al.* (2012) find 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. 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, Smith, and Barnes (2006) show that firms in Canada repurchase at prices that are a remarkable 5.5% lower than prices paid by other investors.

⁴ One line of studies considers stock issues. Baker and Wurgler (2002) show that equity issues predict market returns in the USA, 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 *et al.* (2011) find that the amount of net financing (i.e., issuance less repurchase) is better than issuance alone in predicting returns. For a survey of the theoretical literature about repurchases, see, for example, Allen and Michaely (2003).

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 USA, De Ridder and Rasbrant (2013) 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.⁵ The evidence about postrepurchase activity returns, however, is mixed. In the USA, CKL (2004) do not find abnormal returns following actual repurchase activity, but De Cesari *et al.* (2012) find positive abnormal returns consistent with our results. Outside the USA, 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, Lakonishok, and Vermaelen (2000), and McNally, Smith, and Barnes (2006), also report price increases after repurchase activity. Ginglinger and Hamon (2007), however, find no significant price increases after actual repurchase activity in France.

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, 2012), and between actual repurchases and insider ownership/compensation (e.g., Kahle, 2002; Babenko, 2009). Core *et al.* (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 (2013) 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 announcements of open-market repurchase programs in the USA. Program announcements and their impact on prices and liquidity have been studied extensively (e.g., Vermaelen, 1981; Comment and Jarrell, 1991, and more recently, Grullon and Michaely, 2004). Program announcements and actual repurchases are, however, different events. Most actual

⁵ For US evidence, see Stephens and Weisbach (1998) and CKL (2004); Canada (Ikenberry, Lakonishok, and Vermaelen, 2000, McNally, Smith, and Barnes, 2006); Hong Kong (Zhang 2005); and France (Ginglinger and Hamon, 2007).

repurchase activity is spread over a period that lasts up to 3 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; Bonaime, 2013). 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, Lakonishok, and Vermaelen, 1995; Peyer and Vermaelen 2009).

3. Data

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 the Appendix A.

Our sample consists of CRSP firms selected based on NYSE size decile breakpoints as of December 2003. The sample period covers 72 months between January 2004 and December 2009. We initially randomly picked seventy firms from each size decile. To enter the sample, a firm had to have at least one-quarter of repurchase within the sample period, where the repurchase information for this criterion was taken from Compustat. We then matched the random sample of 700 firms with the SEC 10Q and 10K filings for the sample period, based on the firm’s ticker and CIK numbers. The SEC filings available on the SEC website (www.sec.gov) include detailed information about the monthly repurchase activity. The data include the firm name, CIK number, ticker, number of shares repurchased, the average repurchase price during the month, and the number of shares remaining on the firm’s repurchase program available for repurchase. We then retrieved this

detailed information manually from the filings. From the original sample of seventy firms per decile, we eliminated firms that were delisted and therefore had no filings available on www.sec.gov. We also eliminated firms with erroneous repurchase data and firms that could not be matched correctly with the CRSP data, resulting in 620 firms.⁶ Data on outstanding shares, trading volume, prices, dividend yields, and returns were obtained from the CRSP. Data on accounting variables were obtained from Compustat. Data on analysts' earnings forecast and earnings announcement were obtained from IBES, and data on insider trading were obtained from Thomson Reuters.

For the 620 firms of our sample, 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 made directly from managers). These monthly observations were eliminated from the sample.⁷ Monthly observations were also removed if a review of the financial report revealed that they were accelerated stock repurchase transactions rather than open-market repurchases, even though they were reported under open-market transactions.⁸ 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 (378 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 72 months because they were delisted (for various reasons). We adjusted these firms' returns for the specific delisting month using CRSP delisting returns data.⁹ The final

⁶ After omitting the firms with missing data, the minimum number of firms in each decile is 62. In order to have an even sample, we reduced the number of firms in all deciles to 62, resulting in 620 firms.

⁷ 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.

⁸ Accelerated stock repurchase transactions were removed from the sample because they are performed in the open market over several months after they are reported. See, for example, Michel, Oded, and Shaked (2010).

⁹ 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).

sample consists of 41,409 monthly observations from 620 firms, of which 13,624 are nonzero repurchases.

4. Sample Statistics

Table I reports general characteristics of the firms in the sample. Panel A provides statistics of the complete sample of 620 firms. In the table, *Mean* is the average of the firm-level averages, *Median* and *SD* are the median and standard deviation of the firm-level averages, respectively. The mean (median) market capitalization of the firm, *Size*, is about \$8.2 (\$1.7) billion, and the mean (median) market-to-book ratio, *MB*, is 1.396 (1.120). The mean (median) monthly dividend yield presented as a percentage, *DivYld*, is 0.104% (0.064%). The mean (median) monthly return, *Ret*, is positive at 0.76% (0.79%). The mean (median) monthly abnormal return, *Alpha*, measured using a 4-factor model that includes the three Fama–French (1993) factors and the Carhart (1997) momentum factor, is negative at 0.184% (0.059%). The mean (median) monthly standard deviation of return, *RetStd*, is 2.51% (2.39%).

Panel B of Table I provides repurchase statistics. The 1st variable, *RepFreq*, is the fraction of months in which a firm in our sample repurchased as a fraction of total months the firm appears in the data. The mean (median) *RepFreq* is 32.8% (26.4%), and indicates that, on average, firms repurchase in about a third of the months in the sample. We next report repurchase statistics for all months and also conditional on months with repurchase. The mean monthly dollar value repurchased by a firm, *Rep*, is \$19.73 million and \$38.71 million in repurchase months. The mean monthly repurchase as a percentage of firm size by a firm, *RepYld*, is 0.184% and 0.730% in repurchase months. Mean repurchase as a fraction of monthly trade in the stock, *ReptoDvol*, is 1.47% and 5.27% in repurchase months.

To explore whether repurchase activity exhibits a specific trend during the sample period, in Figure 1, we report the evolution over time of actual repurchase activity and dividend payouts as a fraction of firm size in our sample. The figure suggests that repurchase activity has grown over time during most of the sample period, with the exception of the recent financial crisis, which caused a significant drop in repurchase activity, mostly in 2009.

In an unreported analysis, we also investigated differences in actual repurchases among fiscal quarters and among months within the quarter for the 620 firms. We found no significant difference in actual repurchase activity among the fiscal quarters. However, we did find systematic variability in repurchase activity within the quarter months. Specifically, for the

Table I. Summary statistics

The table reports the sample statistics of the complete sample of 620 firms. *Mean* is the average of the firm-level averages, *Median* is the median of the firm-level averages, and *SD* is the standard deviation of the firm-level averages. In Panel A: *Size* is the firm market capitalization, calculated as the outstanding shares multiplied by the CRSP price at the end of the previous month (in millions of dollars). *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 eight firms were eliminated because of negative MB or missing components for the calculation of *MB*. *DivYld* is the monthly dollar value of the firm's ordinary dividend 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 4-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, Chordia, and Subrahmanyam (1998). The variables *Ret* and *Alpha* are adjusted for delisting following Shumway (1997). *RetStd* is the standard deviation of the return, calculated for each month as the standard deviation of the daily returns within the month. In Panel B: “in-Rep-Mon” refers to the statistics during months of repurchase. *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, then the repurchase frequency is 50%. *Rep* 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 (in millions of dollars). *RepYld* is the monthly dollar value of the firm's repurchase as a percentage of the firm's market capitalization in the previous month (in percent). *ReptoDvol* is the repurchase dollar value as a percentage of the dollar volume of trade in the stock in the repurchase months (in percent).

Variables	Mean	Median	SD
Panel A			
<i>Size</i> (\$millions)	8,236.20	1,691.88	25,596.63
<i>MB</i>	1.396	1.120	1.101
<i>DivYld</i> (%)	0.104	0.064	0.132
<i>Ret</i> (%)	0.757	0.789	1.368
<i>Alpha</i> (%)	0.184	0.059	2.821
<i>RetStd</i> (%)	2.508	2.390	0.881
Panel B			
<i>RepFreq</i>	0.328	0.264	0.253
<i>Rep</i> (\$ Millions)	19.73	2.09	94.66
<i>Rep-in-Rep-Mon</i> (\$ Millions)	38.71	11.53	110.69
<i>RepYld</i> (%)	0.184	0.136	0.165
<i>RepYld-in-Rep-Mon</i> (%)	0.730	0.518	0.785
<i>ReptoDvol</i> (%)	1.467	0.943	2.003
<i>ReptoDvol-in-Rep-Mon</i> (%)	5.267	3.616	8.308

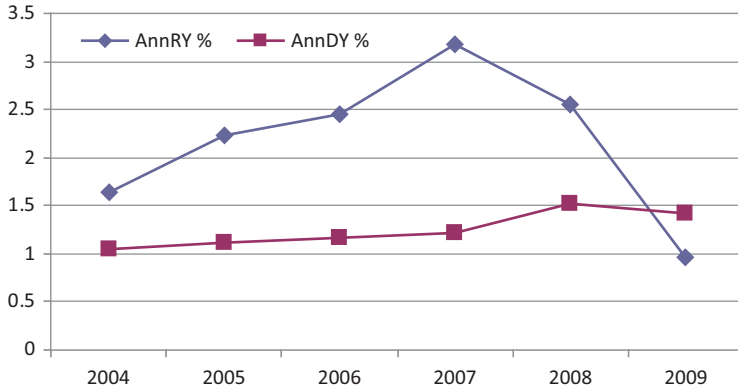


Figure 1. Repurchase yield and dividend yield over time. The figure depicts the cross-sectional averages of the annual repurchase yield (AnnRY(%)) and divided yield (AnnDY(%)), for the 620 firms in our sample during 2004–09.

complete sample, the average repurchase activity in the 1st month of the quarter is 0.125% of the shares, whereas it is 0.242% and 0.194% for the 2nd and 3rd months of the fiscal quarter, respectively. The difference between the 1st month and the 2nd and 3rd month of the quarter is significant at the 1% level. (The results were obtained using Wald test with clustering.)

In Table II, we report the dependency of variables related to repurchase, payout policy, and other firm characteristics on firm size (*Size*) and *MB*. We focus on *Size* and *MB* as past research has shown repurchase is strongly related to these variables (e.g., Grullon and Michaely, 2004; Peyer and Vermaelen, 2009). All variables in Table II are calculated based on 620 firms (including 41,409 repurchase and nonrepurchase months). Panel A reports the dependency of repurchase and other firm characteristics on firm size. Specifically, we sort the repurchasing firms into three equal-size groups by their average size (market capitalization) over the sample period, and report characteristics of the different size terciles. The bottom three rows report the difference between the large- and the small-firm group, and the statistical significance of the difference using *t*-statistics and the Wilcoxon nonparametric test.

Column (1) of Panel A reports the average firm size of the different terciles, showing significant variability in size across the groups (given the selection of the sample based on NYSE breakpoint). Column (2) reports “the repurchase yield,” (*RepYld*), that is, the average monthly dollar value of a firm’s repurchase as a percentage of the firm’s market capitalization in the preceding month. *RepYld* is greater in the large-size group relative to the small-size group (0.215% versus 0.142%), and the difference is statistically

Table II. Repurchasing firms' characteristics: dependency on firm *Size* and *MB*

The table reports the dependency of repurchasing firms' characteristics on firm *Size* and *MB*. Firm *Size* is the average market capitalization over the sample period 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 (in millions of dollars). *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]. We sort the 620 firms into three equally sized groups by firm *Size* (Panel A) and firm *MB* (Panel B). 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. *RepYld* is the monthly dollar value of the firm's repurchases as a percentage of the firm's previous month market capitalization (in percentage). *DivYld* 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 (in percentage). *TotYld* is the sum of *RepYld* and *DivYld*. *ReptoTotYld* is the firm's *RepYld* divided by *TotYld*. *Rep 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 no. 18, Income before Extraordinary Items from Compustat). *Div Payout Ratio* and *Total Payout Ratio* are calculated similarly. *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%. *RetStd* is the standard deviation of the return, calculated for each month as the standard deviation of the daily returns within the month. For Panels A and B, *t*-stat of difference is the *t*-statistic for the difference between the small and large group. Wilcoxon of difference is based on the Wilcoxon test.

Panel A: repurchase and firm characteristics—dependency on <i>Size</i>											
	<i>Size</i>	<i>RepYld</i>	<i>DivYld</i>	<i>TotYld</i>	<i>ReptoTotYld</i>	<i>Rep Payout Ratio</i>	<i>Div Payout Ratio</i>	<i>Total Payout Ratio</i>	<i>Rep Freq</i>	<i>RetStd</i>	<i>MB</i>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Small-firm group	478	0.142	0.078	0.220	0.73	0.374	0.182	0.556	0.224	3.067	1.24
Medium-sized firm group	1925	0.196	0.097	0.293	0.76	0.490	0.229	0.719	0.289	2.408	1.45
Large-firm group	22442	0.215	0.134	0.350	0.64	0.477	0.304	0.781	0.478	2.048	1.53
Difference large less small		0.07	0.06	0.13	-0.09	0.10	0.12	0.23	0.25	-1.02	0.30
<i>t</i> -stat of difference		4.74	4.70	7.45	2.67	2.47	3.75	4.81	10.78	12.94	2.60
Wilcoxon of difference		5.17	6.11	7.51	3.76	4.00	5.33	5.43	9.29	11.43	3.33
Panel B: repurchase and firm characteristics—dependency on <i>MB</i>											
	<i>MB</i>	<i>RepYld</i>	<i>DivYld</i>	<i>TotYld</i>	<i>ReptoTotYld</i>	<i>Rep Payout Ratio</i>	<i>Div Payout Ratio</i>	<i>Total Payout Ratio</i>	<i>Rep Freq</i>	<i>RetStd</i>	<i>Size</i>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Value firm group	0.570	0.146	0.159	0.306	0.55	0.294	0.339	0.633	0.328	2.559	6279
Medium firm group	1.228	0.199	0.094	0.293	0.73	0.482	0.232	0.714	0.320	2.526	9025
Growth firm group	2.416	0.208	0.056	0.265	0.83	0.568	0.143	0.712	0.344	2.438	9541
Difference growth less value		0.06	-0.10	-0.04	0.27	0.27	-0.20	0.08	0.02	-0.12	3261.31
<i>t</i> -stat of difference		4.00	8.95	2.30	9.44	6.57	6.75	1.63	0.64	1.34	1.53
Wilcoxon of difference		4.44	8.43	2.48	8.45	6.96	6.81	1.68	0.71	1.00	1.71

significant at the 1% level, indicating that large firms repurchase a higher fraction of their value. Next, *DivYld* (Column (3)) is the monthly dividend yield represented as a percentage. Like the repurchase yield, the dividend yield increases with firm size. The average monthly dividend yield in the large-firm group is 72% greater than that in the small-firm group (0.134% versus 0.078%, respectively), and the difference is statistically significant at the 1% level. The resulting *TotYld*=(Column (4)), which is the sum of *RepYld* and *DivYld*, is also higher for large firms and is significant at the 1% level. The variable *ReptoTotYld*, the ratio of *RepYld* to *TotYld*, is significantly higher for small firms, suggesting that small firms use repurchases as their main payout tool, whereas large firms make greater use of dividends.

Columns (6–8) report payout relative to earnings (ratio) rather than market value (yield) across the size groups. The findings for the payout ratios (repurchase, dividend, and total payout) are qualitatively similar to the findings for the yield; that is, the differences in these ratios between the large- and the small-firm group are positive and statistically significant at the 1% level. Column (9) reports repurchase frequency, *RepFreq*, calculated as the ratio of number of months in which a given firm reported a positive repurchase value to total number of months in which it appears in the sample. As Panel A indicates, larger firms repurchase more frequently: repurchase frequency is 22.4% in the small-firm group and 47.8% in the large-firm group, and the difference is statistically significant at the 1% level. Standard deviation of return (*RetStd*, Column (10)), is higher for smaller firms, consistent with smaller firms being associated with higher information asymmetry. For completeness, the last column reports MB ratios, showing that they are higher for large firms relative to small firms.

Panel B of Table II reports the dependency of the repurchase characteristics and other firm characteristics considered in Panel A of Table II on MB in a similar manner. Specifically, instead of sorting over size, we sort over MB and report payout characteristics of the different MB terciles. Although *RepYld* is higher in growth firms, *DivYld* is significantly higher for value firms, and as a result *TotYld* is higher for value firms. These findings suggest that growth firms use repurchases as their main payout tool, whereas value firms focus more on dividends. Indeed, the ratio between repurchase yield to total payout yield, *ReptoTotYld*, is significantly higher for growth firms relative to value firms.

Similarly to Panel A, Columns (6–8) of Panel B report results for payout ratio that are similar to the results for payout yield. Namely, repurchase payout ratio is higher for growth firms, whereas dividend payout ratio is higher for value firms. Overall, the analysis across MB groups suggests that high MB firms repurchase more, whereas low MB firms pay more dividends.

This evidence is consistent with the earlier literature that young growth firms prefer to disburse cash through repurchases, whereas value firms tend to disburse cash through dividends (e.g., Fama and French, 2001; Grullon and Michaely, 2002). Interestingly, unlike the dependency of *RepFreq* on size found in Panel A, *RepFreq* is similar across MB groups. Similarly, unlike the case for size, there is no significant difference in *RetStd* between growth and value firms. For completeness, the last column reports the size of the MB groups and shows it is about one and a half times higher for growth firms relative to value firms.

5. Repurchase, Realized Return, and Liquidity

We next investigate the manner in which repurchase activity is related to market conditions, namely, to past and current (realized) return and to liquidity. We utilize a Probit model where the dependent variable receives the value of one in months with repurchase activity and zero otherwise (Using a Tobit model instead yields qualitatively similar results.).

Table III reports the findings of the Probit analysis. We use the following notation for the independent variables. *Ret* is the repurchase month return in month t . Lags of the return are defined in a similar manner. In the specifications, we also control for lagged repurchase activity using *RepYld*. In order to measure the change in the dependent variable resulting from a unit change in any independent variable, we estimate the variables' marginal effects at the mean of the explanatory variables.¹⁰

The coefficients in Table III are reported multiplied by 100 for ease of presentation. The results clearly indicate that repurchase activity is negatively related to both current and past return.¹¹ The marginal effect of *Ret* is significant in all regressions. The marginal effect of *Ret* ($t-1$), the 1-month lagged return, is negative and significant, and the marginal effect of *RepYld* ($t-1$), the 1-month lagged fraction of shares repurchased is positive and significant (Regression 2). When we use three lags of *Ret* and three lags of *RepYld* together in Regressions (3) through (4), the explanatory variables lagged *Ret* in months $t-1$ and $t-2$ and lagged *RepYld* in months $t-1$, $t-2$, and $t-3$, and are significant. However, lagged *Ret* in month $t-3$ is

¹⁰ In the regressions reported, we include time dummy variables and firm dummy variables.

¹¹ To give economic meaning to the coefficients, both panels report the marginal effects of the estimation, estimated at the mean of the explanatory variables. See, for example, Dittmar (2000).

Table III. Repurchase and realized return—Probit model

The table reports the determinants of monthly repurchase activity using the Probit model. The analysis is based on 41,409 observations (months with and without repurchases). The dependent variable is the monthly fraction of shares repurchased *RepYld*, measured as the ratio between the repurchase dollar value in month *t* and the previous month market capitalization (in percentage). For the Probit specification, *RepYld* is replaced with the value of one for repurchase months and zero for nonrepurchase months. To give an economic meaning to the coefficients, the table reports the marginal effects of the estimation, estimated at the mean of the explanatory variables. *Ret* is the return in month *t* adjusted for delisting, following Shumway (1997). All regressions include time and firm dummy variables, and the *t*-statistics (in parentheses) are clustered by firm. The *t*-statistics of the marginal effects are estimated using the delta method. All coefficients are multiplied by 100 for ease of presentation.

Variables	(1)	(2)	(3)	(4)
<i>Ret</i>	-0.055 [2.38]			-0.079 [3.15]
<i>Ret(t-1)</i>		-0.173 [7.19]	-0.183 [7.42]	-0.184 [7.35]
<i>Ret(t-2)</i>			-0.095 [4.23]	-0.098 [4.30]
<i>Ret(t-3)</i>			-0.018 [0.86]	-0.017 [0.89]
<i>RepYld(t-1)</i>		15.043 [9.14]	13.714 [9.91]	13.727 [9.93]
<i>RepYld(t-2)</i>			4.328 [4.89]	4.350 [4.90]
<i>RepYld(t-3)</i>			6.600 [9.69]	6.608 [9.71]

insignificant.¹² To gain a sense of the implied economic magnitude, consider the impact of a change in *Ret(t-1)* on the change in *RepYld*. Recall that the average *Ret* is 0.757% (see Table I, Panel A), and consider, for example, specification (3) of Table III. The coefficient of *Ret(t-1)* is $-0.00183 = -0.183/100$ (as mentioned above, coefficients in the table are multiplied by 100). Thus, estimating the marginal effect at the average values, an increase of 1 SD (12.09%)¹³ in *Ret(t-1)*, from 0.757% (see Table I, Panel A) to

¹² 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.

¹³ We calculate the average firm-level standard deviation (not tabulated) to be 12.09%, as opposed to the cross-sectional standard deviation of the firm mean return, which is 1.368% as reported in Table I, Panel B.

12.84%, will result in a decrease of -0.024% in *RepYld*, from 0.184% (see Table I, Panel A) to 0.160%, or a decrease of about 13% in *RepYld*.

Overall, the findings in Table III suggest that repurchase activity is negatively related to both current and past return. This relation between negative return and repurchase activity fades after approximately 3 months. Although Table III considers return and its lags, replacing *Ret* with *Alpha* results in similar qualitative findings.

Given our findings in Table I that firms repurchase, on average, only in about a third of the months, we next investigate whether the decision to repurchase is related to market liquidity. For this purpose, we include only firms that had both repurchase months and nonrepurchase months (i.e., we exclude four firms that repurchased in every month during the sample period). Accordingly, the analysis of the relation between repurchase activity and stock liquidity is based on 616 firms. The characteristics are equally weighted within each of these 616 firms for all months the firm has in the sample (repurchase months and nonrepurchase months) and then equally weighted across firms. We measure liquidity using the half bid–ask spread, *Half Bid-Ask Spread (HBAS)*, and the volume of trade in dollars, *Dollar Volume (DVOL)*. Our findings are reported in Table IV. As is reported in Row (1), for the complete sample, the mean *HBAS* is 0.17%, and the mean *DVOL* is \$1294.7 million. Rows (2–4) investigate the difference in liquidity characteristics in repurchase months versus nonrepurchase months. We compute the percentage gap (difference) in *HBAS* and *DVOL* between repurchase and nonrepurchase months within each firm, $((\text{Rep} - \text{NonRep})/\text{NonRep})\%$, and then report the average of this difference across firms. As shown in Rows (2–4), this gap is negative and highly significant for *HBAS* and positive and highly significant for *DVOL*. Specifically, for *HBAS*, the average gap is -4.2% of the spread and for *DVOL* it amounts to 12.7% of the volume.¹⁴

Rows (5–8) report the results of a binomial test of the relation between repurchase and these liquidity variables. For each of the variables, *HBAS*, and *DVOL*, we counted the number of firms for which the average value of the variable in repurchase months less the average value in nonrepurchase months is positive, and the number of firms for which it is negative. There were 392 firms (64%) for which average *HBAS* in repurchase months was lower than in nonrepurchase months (a negative difference in *HBAS*), but only 224 firms (36%) for which average *HBAS* in repurchase months was

¹⁴ 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.

Table IV. Liquidity statistics of repurchase versus nonrepurchase months

The table reports liquidity statistics of firms in our sample in repurchase months and nonrepurchase months. We include only firms with repurchase months and nonrepurchase data; of the sample of 620 firms, 616 firms had both repurchase months and nonrepurchase months. For each firm, we calculate the average of the characteristic in the repurchase months and in the nonrepurchase months and then calculate the percentage 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 (in percentage). *DVOL* is the average monthly dollar volume of trade in the stock on the market (in millions of dollars). Row (1) reports the average of the firms' *HBAS* and *DVOL* for all the months in our sample. (Rep - NonRep)/NonRep in Row (2) is the average of the firm-level difference between repurchase and nonrepurchase month averages divided by nonrepurchase month average (in percentage). The statistical significance of the difference is reported in Rows (3) and (4). Rows (5-8) report the results of a binomial test of the relation between repurchase and liquidity. For each of the variables, 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 nonrepurchase 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, assuming equal chances for positive and negative outcomes.

		HBAS	DVOL
(1)	All months	0.170	1294.7
(2)	(Rep - NonRep)/NonRep (%)	-4.223	12.726
(3)	<i>p</i> -value	0.026	<0.0001
(4)	<i>t</i> -statistic	2.24	5.73
(5)	Negative, <i>n</i> (%)	392 (64)	266 (43)
(6)	Positive, <i>n</i> (%)	224 (36)	350 (57)
(7)	<i>N</i>	616	616
(8)	Binomial tests <i>p</i> -value	<0.001	<0.001

higher than in nonrepurchase months (a positive difference in *HBAS*). There were 266 firms (43%) for which average *DVOL* in repurchase months was lower than in nonrepurchase months (a negative difference in *DVOL*), and 350 firms (57%) for which average *DVOL* in repurchase months was higher than in nonrepurchase months (a positive difference in *DVOL*). The difference in the number of firms is statistically significant at the 1% level for both *HBAS* and *DVOL* (bottom row of the table).¹⁵ The results of this nonparametric test are thus consistent with the results reported for the *t*-statistics of *HBAS* and *DVOL* in repurchase months versus nonrepurchase months.

¹⁵ Confirmed with a binomial distribution test under the assumption of equal chance for positive and negative outcomes.

Overall, the results in Table IV indicate that actual repurchase activity is negatively related to the bid–ask spread and positively related to market volume and turnover. Together, these findings suggest that liquidity is higher in repurchase months.

6. Repurchase Price Analysis

In this section, we investigate whether firms repurchase their shares at prices below the average 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).

6.1 THE DIFFERENCE BETWEEN REPURCHASE PRICE AND MARKET PRICE AND ITS DETERMINANTS

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.¹⁶ 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.

Our analysis of *Diff* is based on 13,624 months with nonzero repurchase observations. The market price input for *Diff* is the market price from CRSP, value weighted within the month based on daily trade volume. We first calculate the average *Diff* based on all 13,624 repurchase observations

¹⁶ 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.

(equally weighted) and find it to be -0.266% and statistically significant at the 1% level (t -statistic 3.83), indicating that, on average, firms repurchase their stock at prices lower than the market price.¹⁷

Next, in Table V, we report the results of the regression analysis of *Diff*, the difference between average monthly repurchase price and average monthly market price. Panel A reports the results of several multivariate specifications. We consider the following explanatory variables. The 1st variable we consider is *LnSize* ($t - 1$), the 1-month lag of the natural log of the firm's market capitalization. We use the 1-month lag to avoid the impact of the repurchase during the month on size. Given earlier evidence that repurchase activity is related to MB (e.g., Grullon and Michaely, 2002; Peyer and Vermaelen, 2009), the next variable we consider is *LnMB*, the natural log of the firm's MB ratio, where MB ratio is calculated as in Grullon and Michaely (2002) using Compustat yearly data, with Pontiff and Woodgate's (2008) approach to missing values.¹⁸ Next, *HBAS* ($t - 1$) is the 1-month lag of the bid-ask spread.¹⁹ *RepFreq* is the ratio of repurchase months to total number of months the firm has in the sample. *RepYld-in-RepMon* is the ratio between the monthly repurchase dollar value and the market capitalization of the firm in the previous month. *ReptoDvol* 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. *RetStd* ($t - 1$) is the 1-month lag of the return standard deviation, and *ReptoTotYld* is the ratio of repurchase to total yield (dividends plus repurchase).

¹⁷ Calculating *Diff* equally weighted rather than value-weighted yields similar results. Specifically, when calculating the average difference per firm over monthly observations, and then taking the average across 620 firms, the average is 0.319% and is significant at the 1% level. 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 the Mann-Whitney nonparametric test and or simulated t -statistics using bootstrapping of medians) are also qualitatively similar. For robustness, we have also verified that when we split our sample period into 2004-06 and 2007-09, and calculate *Diff* separately for each of the subperiods, *Diff* is negative and significant in both subperiods.

¹⁸ First, stocks with negative or missing values of MB get the value of zero. The MB variable thus includes stocks with a logarithm of the positive MB and stocks with zero values. Then a dummy variable (*BMdum*) takes the value of one, whenever the MB exists and is positive; and zero otherwise. Finally, in the regressions, both the dummy and the book-to-market variable are included.

¹⁹ 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.

Table V. Analysis of the difference between repurchase price and market price

The table reports results from panel regression of the *Diff* measure. The analysis is based on 13,624 nonzero 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 percentage). 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 trading volume. The measure is winsorized around the 1% tails of its distribution. Panel A (Panel B) presents results from multivariate (univariate) panel regressions on set of explanatory variables. *LnSize* ($t-1$) is the 1-month lag of *LnSize*, where *LnSize* is the natural log of the firm's market capitalization. The firm's market capitalization is calculated as the outstanding number of shares times the CRSP price at the end of the previous month (in millions of dollars). *LnMB* is the natural log of the firms *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. *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 (in percentage). *RepFreq* is the ratio between months with repurchase to total months that the firm appears in the sample. *RepYld* is the ratio between the monthly repurchase dollar value and the firm's previous month's market capitalization (in percentage). *RepYld-in-Rep-Mon* is *RepYld* in repurchase months. *ReptoDvol* 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 (in percent). *RetStd* ($t-1$) is the 1-month lag of the standard deviation of the return, calculated for each month as the standard deviation of the daily returns within the month. *ReptoTotYld* is the firm's *RepYld* divided by *TotYld*, where *TotYld* is the sum of *RepYld* and *DivYld*. *RepYld* is the monthly fraction of shares repurchased measured as the ratio between the repurchase dollar value in month t and the previous month market capitalization (in percentage). *Divyld* 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 (in percentage). The regressions include time dummy variables and the t -statistics (in parentheses) are clustered by firm.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A								
<i>LnSize</i> ($t-1$)	0.074 [2.23]	0.138 [5.01]	0.090 [2.79]	0.096 [2.93]	0.102 [3.66]	0.102 [3.42]	0.078 [2.60]	
<i>LnMB</i>	-0.316 [5.22]	-0.290 [5.11]	-0.281 [4.80]	-0.296 [4.98]	-0.296 [5.03]	-0.296 [5.06]	-0.215 [3.45]	
<i>HBAS</i> ($t-1$)		0.807 [4.82]	0.772 [4.77]	0.790 [4.80]	0.698 [5.01]	0.698 [5.01]	0.645 [4.49]	
<i>RepFreq</i>			0.709 [3.52]	0.786 [3.83]	0.739 [3.91]	0.739 [3.76]	0.801 [4.09]	
<i>RepYld-in-Rep-Mon</i>				0.148 [3.76]	0.099 [2.29]	0.099 [2.28]	0.137 [3.04]	
<i>ReptoDvol</i>					0.087 [1.86]	0.087 [1.85]	0.086 [1.79]	
<i>RetStd</i> ($t-1$)						-0.031 [0.53]	-0.020 [0.35]	
<i>RepToTotYld</i>							-0.572 [3.27]	
<i>Adj-RSQ</i> (%)	2.49	3.27	3.48	3.61	3.87	3.85	4.06	

(continued)

Table V. (Continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel B								
<i>LnSize</i> ($t-1$)	0.046 [1.66]							
<i>LnMB</i>		-0.278 [2.37]						
<i>HBAS</i> ($t-1$)			0.653 [4.35]					
<i>RepFreq</i>				0.838 [5.01]				
<i>RepYld-in-Rep-Mon</i>					0.061 [1.64]			
<i>ReptoDvol</i>						0.107 [2.04]		
<i>RetStd</i> ($t-1$)							-0.003 [0.05]	
<i>RepToTotYld</i>								-0.822 [5.02]
<i>Adj-RSQ</i> (%)	1.98	2.36	2.52	2.30	1.95	2.40	1.92	2.40

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. Consider first the findings for the impact of *LnSize* and *LnMB* on the *Diff* measure.

As Panel A shows, the coefficient of *LnSize* is positive and significant in all regressions, suggesting that small firms repurchase shares at lower prices relative to large firms. Similarly, the coefficient of *LnMB* is negative and significant in all regressions suggesting that growth firms (high MB firms) are better than value firms at repurchasing at discounted prices. This result holds after controlling 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 and MB in all regressions, suggesting that given size and growth opportunities, 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 infrequently do so at favorable prices. The coefficients of *RepYld-in-RepMon*, the ratio between the firm's monthly repurchase volume and market capitalization, and *ReptoDVol*, the ratio between the monthly repurchase dollar value and the monthly market dollar volume, are both positive and significant,

suggesting that the more the firm repurchases from the outstanding shares or relative to the market dollar volume, the less it is able to repurchase at discounted prices. This result is consistent with the findings for *RepFreq*. 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. However, the coefficient of *ReptoTotYld* is negative and significant, indicating that firms that focus their payout policy more on repurchase relative to dividends, buy their shares at more discounted prices.

For robustness, in Panel B of Table V, we present univariate regressions in which *Diff* is the dependent variable with each of the independent variables, separately. The findings are consistent with the findings of Panel A: except for *RetStd*, all coefficients are significant and their sign is the same as in Panel A. In an unreported analysis, we also re-estimate Panels A and B of Table V using one observation per firm (the firm averages of the dependent and explanatory variable) instead of a panel of 13,624 observations and find qualitatively similar results.

In sum, the regression results in Table V suggest that small firms and growth firms (high MB firms) buy at favorable prices within the month. Repurchasing less relative to size or infrequently, and repurchasing with higher liquidity (measured through *HBAS* or *Dvol*) are also associated with more discounted repurchase prices.²⁰ Furthermore, the more a firm's payout policy is focused on repurchase relative to dividends the higher the discount.

It has been suggested to us that smaller firms tend to repurchase "in house," whereas larger firms delegate their repurchase activity to a broker, consistent with our interpretation that only smaller firms repurchase strategically. However, we were not able to confirm this as the relevant information is not publicly available.²¹

As for the relation between repurchase and liquidity, Table III suggests that the higher the liquidity, the higher the discount, but does not indicate causality. That is, it does not tell whether repurchase activity increases

²⁰ Turnover, however, a commonly used measure of liquidity, was insignificant in all regressions when included.

²¹ In fact, we polled a random sample of 158 CFOs for whom we were able to get contact information, whether they repurchase in house or use a broker. We got replies from sixteen firms of which three (average size \$13.4 billion) reported they repurchase in house, whereas thirteen firms (average size \$6.9 billion) reported they use an outside broker. However, most firms that use a broker reported they frequently instruct the broker when and how much to repurchase. Given the low response rate, we unfortunately cannot make any formal analysis of these findings.

liquidity, or firms choose to repurchase in months where repurchase activity is high. However, Table V 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 provides it, because a liquidity consumer is adversely affected by the bid–ask spread, whereas a liquidity provider benefits from the bid–ask spread.²²

Lastly, the notion “benefit from underpricing” deserves further clarification. Since 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.²³

6.2 ECONOMIC SIGNIFICANCE OF FIRM DISCOUNT *DIFF*

Given the findings that size and MB are highly significant in explaining *Diff* (Table V), we next explore the economic significance of *Diff* by sorting the sample into size and MB groups. Since we independently sort on size and MB, we use the sample of 612 firms with MB information. We sort the 612 repurchasing firms into three equal-size groups by their average size (market capitalization), and, independently, into three equal-size groups based on their average MB over the sample period, where MB is calculated as in Grullon and Michaely (2002). We then allocate the firms into 3×3 groups according to this sort by size and MB ratio.²⁴

Table VI reports averages and *t*-statistics of the *Diff* measure based on an independent sort of size and MB ratio. We also include a summary row and column (the bottom row reports averages for the different MB groups and the right-most column reports averages for the different size groups). The results in Table VI are consistent with the regression results of Table VI.

²² McNally and Smith (2011), however, find that in Canada most repurchase orders are limit orders and hence suggest that repurchases provide liquidity. In the USA, data on order type (limit or market) are not publicly available.

²³ 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).

²⁴ Since the sorts are independent, the number of firms in the nine bins is uneven. For example, among the small-size firms, there are eighty-two low MB (value) firms and only fifty-seven high MB (growth) firms.

Table VI. Economic magnitude of the difference between repurchase price and market price

The table reports averages of the *Diff* measure based on an independent sort of *Size* and *MB*. We have full *Size* and *MB* information for 612 firms of our 620 firms. *Size* is the firm market capitalization calculated as the outstanding shares multiplied by the CRSP price at the end of the previous month (in millions of dollars). *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]. *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 percentage). 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. We use the firms' *Size* and *MB* values at the beginning of our sample to rank the firms into independent *Size* and *MB* terciles. We then present results for the three-by-three *Size*–*MB* portfolios. *Size 1*–*Size 3* refer to small–large firms, respectively; in a similar manner, *MB1*–*MB3* refer to low-to-high *MB* firms. For example, the interaction of *Size 1* and *MB 1* includes 82 firms that are defined as small and growth firms. For each block, we present the average *diff*, together with the *t*-statistics and the number of firms included. We also add an additional row and column that summarize the *Size* and *MB* independent information: the *Size* column summarizes the results of the different *Size* groups regardless of the *MB* interaction; and the *MB* row column summarizes the results of the different *MB* groups regardless of the *Size* interaction.

	MB 1—Value	MB 2	MB 3—Growth	Size
<i>Size 1—Small</i>	–0.125	–0.052	–1.105	–0.376
<i>t</i> -stat	0.66	0.15	2.91	2.19
<i>N</i>	82	65	57	204
<i>Size 2</i>	–0.212	–0.687	–0.697	–0.553
<i>t</i> -stat	1.15	2.74	3.22	4.27
<i>N</i>	59	73	72	204
<i>Size 3—Large</i>	0.296	–0.128	–0.261	–0.046
<i>t</i> -stat	1.20	0.85	2.22	0.45
<i>N</i>	63	66	75	204
<i>MB</i>	–0.020	–0.304	–0.651	–0.325
<i>t</i> -stat	0.17	2.03	4.68	4.08
<i>N</i>	204	204	204	612

Generally, groups with smaller size and higher MB obtain higher (more negative) average *Diff*. Indeed, while the average magnitude of *Diff* across all firms in our sample is –0.325% (bottom right corner of the table),²⁵ the small-size, high-book-to-market group (top line, 3rd column) demonstrates a *Diff* of –1.105%. The lowest average discount (most positive *Diff*) is obtained in the large size, low MB group and is insignificant.

²⁵ This *diff* of –0.325% differs from the *diff* of –0.266% reported just before Table V because here the results are firm-based (one observation per firm), whereas there they are observation based (13,624 months).

7. Actual Repurchase and Future Returns

The results in Section 6 indicate that small firms and growth firms are able to repurchase shares at favorable prices relative to monthly averages. They do not tell us, however, what firms, if any, also have higher returns in the postrepurchase period. For example, if large firms are better informed about their future performance, they might be buying at less favorable prices but still realize high postrepurchase returns.

In this section, we investigate the relation between repurchase activity and future returns. Earlier literature focused on program announcements and found positive long-run abnormal return (Ikenberry, Lakonishok, and Vermaelen, 1995 and, more recently, Peyer and Vermaelen, 2009). Relative to program announcements, monthly actual repurchases are more frequent events and are substantially smaller in magnitude. They are therefore not likely to have long-run impact. Accordingly, our focus is on the short term. In particular, we focus on the impact of the disclosure of repurchase activity on the return. Although 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. Indeed, we have verified this in our sample.²⁶ 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.

7.1 ACTUAL REPURCHASE AND EARNINGS-ANNOUNCEMENT MARKET RESPONSE

Earlier studies that have investigated the relationship between repurchase program announcements and subsequent earnings announcements provide inconclusive evidence.²⁷ Given that many repurchase programs are

²⁶ We randomly chose a sample of 50 quarters per size-decile (total of 500 quarters) in which there was at least one month with actual repurchase of at least \$50,000. We then checked whether the repurchase was reported in the earnings call of the quarter using seekingalpha.com. The average reporting rate was 87% and ranged between 81% and 96% per decile.

²⁷ 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.

announced but not completed, and given 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 VII reports our findings on this relation. The dependent variable is the abnormal return (4-factor *Alpha*) on a 3-day window around the earnings announcement day. *QRepYld* is quarterly repurchase calculated as the sum of the monthly repurchase dollar value relative to the market cap of the firm. 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 receives the value of one in the 1st quarter in which a firm repurchased in the sample period. It also receives the value of one in every other quarter with positive repurchase that follows a pause in repurchase activity of at least one quarter for that firm.

Regression (1) shows that *QRepYld* is highly significant in explaining the earning announcement return. This result indicates that firms that repurchase more relative to other firms have a stronger earnings announcement return. Given that we control for *SUE*, Regression (1) suggests that the actual repurchase information reported in the earning announcement is important for the market in pricing the stock beyond earnings information. To our knowledge, this is the first documentation that the market responds to actual repurchase information beyond its response to earnings surprise. Consistent with this interpretation, when we add *PauseDum* in Regression (2), *PauseDum* is positively significant while *QRepYld* remains positively significant. That is, the market responds positively to new executions in addition to its response to the quantity repurchased. At the same time, these findings may indicate that when firms are privately aware of positive information about their operating performance, they tend to repurchase more. This positive information is revealed in the earning announcement and the market responds accordingly.²⁸ Regressions (3) and (4) show that the results in Regressions (1) and (2), respectively, still hold after the inclusion of firm dummy variables. That is, at the firm level, the higher the

Neither Lie (2005) nor Gong, Louis, and Sun (2008) consider the relation between actual repurchase in the quarter and the earnings announcement return of that quarter.

²⁸ This by itself does not necessarily mean repurchasing firms try to time the market. Given good news, they may feel more comfortable disbursing cash through repurchases. However, the fact that the market responds more strongly given repurchase suggests that there is information in the repurchase beyond the good news about earnings released in the earning announcement.

Table VII. Market response to earnings announcements and actual repurchase

The table reports regression results from panel regressions of earnings announcements abnormal return on actual repurchase and other explanatory variables based on 10,434 announcement events. The dependent variable is the abnormal return (4-factor *Alpha*) on a 3-day window around the earnings announcement from Days -1 to $+1$. If the time of the earnings announcement is before 15:45, 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. *QRepYld* is the quarterly *RepYld*. *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 one in the 1st 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. *Size* is in billions of dollars for ease of coefficient presentation. *LnMB* is the natural log of the MB ratio calculated following Grullon and Michaely (2002) as [(book value of assets + market value of equity – book value of equity)/book value of assets]. *LnMBxQrtRep* is the interaction between *LnMB* and *QrtRep*. *Size* is the firm market capitalization calculated as the outstanding shares multiplied by the CRSP price at the end of the previous month. *Size* is in billions of dollars for ease of coefficient presentation. *Size**xQRepYld* is the interaction between *Size* and *QRepYld*. All regressions include time dummy variables and the *t*-statistics (in parentheses) are clustered by firm.

	(1)	(2)	(3)	(4)	(5)	(6)
<i>QRepYld</i>	0.169 [2.79]	0.129 [2.1]	0.162 [2.51]	0.119 [1.76]	0.060 [0.89]	0.144 [2.24]
<i>SUE</i>	0.116 [2.42]	0.116 [2.42]	0.110 [2.16]	0.110 [2.15]	0.114 [2.39]	0.117 [2.42]
<i>PauseDum</i>		0.800 [2.77]		0.882 [2.84]	0.693 [2.43]	0.766 [2.66]
<i>LnMB</i>					-0.228 [1.51]	
<i>LnMBxQRepYld</i>					0.256 [2.94]	
<i>Size (in \$Billions)</i>						-0.001 [0.29]
<i>Size</i> <i>xQRepYld</i>						-0.002 [0.90]
<i>Firm Dummies</i>	No	No	Yes	Yes	No	No
<i>Adj-RSQ (%)</i>	1.73	1.79	3.43	3.51	1.84	1.81

repurchase during the quarter relative to other quarters, the stronger the earnings announcement return.

Given our earlier findings that size and MB are significant in explaining repurchase activity, we next investigate the dependency of the market response to repurchase data on the variable *Size* and *MB*. To test this dependency, we add two interaction variables: *LnMBxQRepYld* for the

interaction between $LnMB$ and $QRepYld$ and $Size \times QRepYld$ for the interaction between $Size$ and $QRepYld$.²⁹ Regression (5) reports the results for MB . The interaction is significant, which suggests that firms with higher MB have a stronger $QRepYld$ effect than firms with lower MB . This, in turn, suggests that the earnings announcement return is more positively related to actual repurchase for growth than for value firms. Regression (6) reports the interaction with size. Contrary to the results reported for MB , the interaction with $Size$ is not significant, suggesting that size has no impact on the relation between actual repurchase and the earnings announcement return.³⁰ In unreported analysis, we have also verified that when we split our sample period into 2004–06 and 2007–09, and repeat the analysis reported in Table VII, the results are qualitatively similar.

7.2 ACTUAL REPURCHASE AND RETURNS AROUND EARNINGS ANNOUNCEMENT

Given that the market responds favorably to actual repurchase information revealed in the earnings announcement, we next investigate whether the returns before and after the reporting of earnings announcements are related to actual repurchase during the quarter. The motivation is to answer questions such as, is there a drift before the announcement that could indicate leakage of information? Is there a drift after the earnings announcement that is related to actual repurchase information revealed that could indicate inefficiency in assessing the actual repurchase information revealed?

We define the preannouncement period as a 30-day window (calendar days) before the earnings announcement and the postannouncement period as the 30-day window after the earnings announcement. We limit the windows to 30 days in order to avoid overlapping between the post- and the preannouncement periods of and subsequent earnings announcement. We then use regression analysis to investigate the impact of actual repurchase on these returns.

²⁹ Ideally, we would use the log of the variable size rather than size itself as in most studies; however, as $LnSize$ is highly correlated with the interaction variable $LnSize \times QRepYld$, to avoid problems of multicollinearity, we use $Size$ and $Size \times QRepYld$ instead.

³⁰ In an unreported analysis, we also find that the market response to the repurchase information revealed in the earnings announcement is higher in the months just after an increase in program size, measured using the remaining-on-program data from the firm's reporting (see Appendix A). This may indicate that actual repurchases support the credibility of program announcements.

Table VIII reports our results, where Panels A and B report our findings for the pre- and postannouncement periods, respectively. The panels are similar in structure to Table VII: Regressions (1) and (2) are without firm dummies, Regressions (3) and (4) are with firm dummies, and Regressions (5) and (6) include our interaction variables. Consider Panel A first. The dependent variable is the 4-factor adjusted abnormal return in the 30-day preannouncement period. Column (1) reports the results of a regression analysis of *Alpha* on *QRepYld*, where we control for earnings surprise using the variable *SUE*, which measures the difference between actual earnings and average analysts' forecast. Column (2) reports the results when *PausDum* is also included. The results suggest that after controlling for *SUE*, *QRepYld* and *PausDum* are not significant in the preannouncement period. These findings indicate that quarterly repurchase information is not related to the preannouncement period, which, in turn, suggests that there is no leakage of actual repurchase information before the earning announcement. These findings also suggest that the actual monthly repurchase *per se* does not affect stock prices and only the release of information affect stock prices. Columns (3) and (4) report the results when firm fixed effects are included in Regressions (1) and (2), respectively, and show that adding firm fixed effect has no significant impact on the results. Regressions (5) and (6) indicate that the interaction variables of *Size* and *BM* (*SizeXQRepYld* and *LnMBXQRepYld*) are insignificant, indicating that neither size nor MB affect the impact of repurchase on the preannouncement return.

In Panel B of Table VIII, we repeat the analysis performed in Panel A for the postannouncement period. Interestingly, *QRepYld* is significant in explaining the postannouncement period return (Columns (1) and (2)), indicating a positive repurchase-related drift. This, in turn, suggests that while the market reacts to the actual repurchase information revealed in the earning announcement, this reaction underestimates the content of the information revealed, and hence the postannouncement drift.³¹ As in Panel A, adding firm fixed effect has no significant impact on the results (Columns (3) and (4)), indicating our results also hold at the firm level. Interestingly, the interaction variables *SizeXQRepYld* and *LnMBXQRepYld* are insignificant (Columns (5) and (6), respectively), indicating that the drift in the postannouncement period does not depend on either size or MB.

³¹ An alternative explanation for the 1 month drift is that it results from the market reaction to the disclosure of repurchase information in the financial reports of those firms that did not disclose their repurchase information earlier in their earnings announcement (see note 26).

Table VIII. Market response to pre- and postearnings announcements and actual repurchase

The table reports results from panel regressions of abnormal returns (4-factor *Alpha*) on a 30 calendar day window before and after the earnings announcement window, based on 10,434 announcement events. Panel A presents the results for the preannouncement period, and Panel B presents the results for the postannouncement period. *QrtRep* is the quarterly *RepYld*. *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, which receives the value of one in the 1st 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. *LnMB* is the natural log of the MB ratio calculated following Grullon and Michaely (2002) as [(book value of assets + market value of equity) - book value of equity]/book value of assets. *LnMBxQrtRep* is the interaction between *LnMB* and *QrtRep*. *Size* is the firm market capitalization calculated as the outstanding shares multiplied by the CRSP price at the end of the previous month. *Size* is in billions of dollars for ease of coefficient presentation. *Size x QRepYld* is the interaction between *Size* and *QRepYld*. All regressions include time dummy variables and the *t*-statistics (in parentheses) are clustered by firm.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Preannouncement period						
<i>QRepYld</i>	-0.020 [0.29]	-0.033 [0.48]	-0.059 [0.78]	-0.067 [0.89]	-0.024 [0.21]	-0.028 [0.29]
<i>SUE</i>	0.085 [2.71]	0.085 [2.70]	0.063 [2.29]	0.063 [2.29]	0.080 [2.68]	0.084 [2.70]
<i>PauseDum</i>		0.256 [0.87]		0.140 [0.44]	0.248 [0.84]	0.270 [0.91]
<i>LnMB</i>					0.681 [3.32]	
<i>LnMBxQrtRep</i>					-0.073 [0.57]	
<i>Size (in \$Billions)</i>						0.007 [1.48]
<i>Size x QRepYld</i>						-0.002 [0.47]
<i>Firm Dummies</i>	No	No	Yes	Yes	No	No
<i>Adj-RSQ (%)</i>	0.77	0.77	2.59	2.58	0.92	0.77
Panel B: Postannouncement period						
<i>QRepYld</i>	0.234 [3.23]	0.229 [3.13]	0.202 [2.51]	0.195 [2.41]	0.249 [3.04]	0.233 [3.15]
<i>SUE</i>	0.033 [1.90]	0.033 [1.90]	0.026 [1.62]	0.026 [1.62]	0.029 [1.86]	0.036 [1.95]
<i>PauseDum</i>		0.104 [0.32]		0.138 [0.41]	0.092 [0.28]	0.118 [0.36]
<i>LnMB</i>					0.092 [0.60]	
<i>LnMBxQrtRep</i>					-0.064 [0.48]	
<i>Size (in \$Billions)</i>						0.005 [1.39]
<i>Size x QRepYld</i>						-0.001 [0.50]
<i>Firm Dummies</i>	No	No	Yes	Yes	No	No
<i>Adj-RSQ (%)</i>	1.07	1.06	2.81	2.80	1.13	1.07

Overall, our findings in Table VIII indicate that repurchase within the quarter does not affect the return before repurchase during the quarter data are reported in the earnings announcement, suggesting no leakage of information, and that prices do not respond to the contemporaneous repurchase activity. It does, however, affect the postearnings announcement return, indicating that when actual repurchase information is revealed in the earnings announcement, the market does not fully respond to the positive information revealed and the impact continues after the announcement.

7.3 ECONOMIC SIGNIFICANCE OF ABNORMAL POSTREPURCHASE RETURNS

To investigate the economic significance of the relation between actual repurchases and returns, we next form portfolios based on firms' repurchase activity. Specifically, for each quarter, we construct a portfolio in which we buy all firms that had repurchase activity during the quarter and short risk-free debt and hold this position for various horizons. We construct value-weighted portfolios using the variable $QRepYld$ for the firms that we buy and short sell the risk-free debt.³² We then measure the average cumulative *Alpha* relative to the base amount invested, which is equal to the amount shorted in the risk-free rate, for different horizons. When choosing the portfolio horizon, we construct two types of portfolios. The first type is portfolios from the end of each quarter for 1 month up to 3 months. The second type is portfolios around earnings announcement, which allow us to directly account for earnings-announcement return and the postannouncement drift (reported in Tables VII and VIII). For completeness, we also report returns using equally weighted portfolios.

Table IX reports the performance of the above-mentioned repurchase portfolios. Panel A reports cumulative *Alphas* of portfolios constructed from the end of the quarter for 1 month up to 3 months. Specifically, Column (1) reports the average 1-month *Alpha* of portfolios that buy firms that repurchased at the end of each quarter and short the risk-free rate, and held for 1 month. Columns (2) and (3) report the average cumulative 2- and 3-month *Alpha* of portfolios that are constructed in the same manner and are held for 2 and 3 months, respectively. The 1st row of Panel A reports the average cumulative *Alpha* when the portfolio constructed based on $QRepYld$ is repurchase value-weighted. It shows the average 1-month portfolio *Alpha* is positive at 0.643% and significant at the

³² We value weight by repurchase because if repurchase is related to future return, we want to give more weight to larger repurchases.

Table IX. Alphas based on repurchase portfolio

The table reports the average *Alpha* on portfolios that are long repurchasing firms and short the risk-free rate. Each quarter we construct portfolios in which we buy all firms that had a repurchase activity during the quarter and short the risk-free rate. We construct both repurchase value-weighted (*QRepYld* VW) and equally weighted (*QRepYld* EW) portfolios. *QrtRep* is the quarterly *RepYld*, where *RepYld* is the monthly dollar value of the firm's repurchase as a percentage of the firm's market capitalization in the previous month. The *Alpha* return is calculated as out-of-sample alpha, following Brennan, Chordia, and Subrahmanyam (1998) using a Fama–French–Carhart 4-factor model. *Alpha* is adjusted for delisting following Shumway (1997). Panel A presents the average cumulative *Alpha* for portfolios, which start from the end of each quarter. $t+1-t+1$ to $t+1-t+3$ are the 1 to 3 month cumulative alpha returns from the end of the quarter. *QRepYld* VW is the value-weighted portfolio, and *QRepYld* EW is the equally weighted portfolio. Panel B presents the average cumulative *Alpha* for portfolios around earning announcements. Announcement (ANN) is a 3-day window around the earnings announcement from Days -1 to $+1$ (as defined in Table VII). Pre and Post are 30 calendar day windows before and after the earnings announcement window (as defined in Table VIII). Similar to Panel A, *QRepYld* VW is the value-weighted portfolio, and *QRepYld* EW is the equally weighted portfolio. The *t*-statistics are corrected for serial correlation in the residuals following Newey–West (1987).

Panel A: end of quarter portfolios			
	$t+1-t+1$ (1)	$t+1-t+2$ (2)	$t+1-t+3$ (3)
<i>QRepYld</i> VW	0.643 2.89	1.265 2.99	1.172 2.03
<i>QRepYld</i> EW	0.36 1.34	0.46 1.92	0.24 0.95
Panel B: announcement window portfolios			
	<i>Pre</i> (1)	<i>ANN</i> (2)	<i>Post</i> (3)
<i>QRepYld</i> VW	-0.390 1.66	0.751 6.18	0.791 2.78
<i>QRepYld</i> EW	-0.21 1.01	0.45 3.93	0.34 1.53

1% level. The average 2-month portfolio *Alpha* is 1.265% reflecting a similar monthly return as in the 1-month portfolio and is also significant. The 3-month portfolio *Alpha* is lower but still significant at the 5% level. Thus, the highest return is attained on a portfolio that is held for 2 months from the end of the quarter. Since earnings announcements are typically made within a month after the quarter end, this 2-month *Alpha*

captures both the announcement effect and the drift effect. The average *Alpha* of this portfolio is about $1.265\% * 4 = 5.06\%$ annually. (The 2-month return is multiplied by four because the portfolio is constructed once per quarter.)

The 2nd row of Panel A reports the results for portfolios in which *QRepYld* is equally weighted (rather than value weighted). The *Alpha* is still positive but is smaller and is significant only in the 2-month portfolio, and only at the 5% level. A lower *Alpha* for equally weighted portfolios is consistent with the findings in Tables VII and VIII that the response to the actual repurchase information revealed in earnings announcements is positively related to the magnitude of the repurchase. We acknowledge that because the monthly purchases are disclosed only in the financial report, all strategies in Panel A are not feasible for uninformed investors. They do, however, help us assess the economic significance of the relation between actual repurchase and return.

Next, in Panel B of Table IX, we construct portfolios as in Panel A, which are based on the earnings announcement (as opposed to the end of quarter). Specifically, Columns (1–3) of Panel B report the average return on portfolios that are based on the repurchasing firms and that are held for 30 calendar days before the earnings announcement, for the 3-day announcement window, and for the 30 calendar days after the announcement, respectively. Consistent with the results in Table VII, the return on the portfolio of the announcement window (Column (2)) is positive and significant. Consistent with the findings in Table VIII, the return on the portfolio of the preannouncement window (Column (1)) is insignificant, and the return on the portfolio of the postannouncement window (Column (3)) is positive and significant. The return on the portfolio in Column (3) is 0.791% , $0.791 * 4 = 3.16\%$ per year. We also note that unlike the other portfolios in Table IX, this portfolio is feasible for uninformed investors.

The positive and significant return found in Column (3) of Panel B is consistent with the increase in return documented in Column (2) of Panel A. This is because most earnings announcements take place within the 1st month after the quarter end, and hence, the time period in Column (3) of Panel B is usually the 2nd month of the 2-month period considered in Column (2) of Panel A of Table III.

8. Actual Repurchase and Insider Trades

In this section, we investigate the relation between actual repurchase and insider trading activity. Such a relation could be information driven or

liquidity driven. Consider the information motivation first. If insiders trade based on private information, one would expect that when firms repurchase insiders will tend to buy and when firms do not repurchase insiders will tend to sell. The information motivation will thus predict a positive relation between actual repurchase and insider trading. Considering the liquidity motivation, when insiders sell their shares, they may want to do so on days when the firm repurchases and take the other side, 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. The liquidity motivation will thus predict a negative correlation between actual repurchase and insider trading.

We construct our insider trading variable using the Thomson Reuters data base. Specifically, the Thomson Reuters data base defines four levels of insiders according to their relation to the firm, where Level 1 insiders are insiders with the highest relation to the firm (e.g., CEO and chairman), and Level 4 insiders are insiders with the lowest relation to the firm (e.g., a retired shareholder, investment advisor, and voting trustee). We focus on insider trades in the open market and on Level 1 insiders.

Given our findings in Section 7 that the earnings announcement return is positively related to the repurchase information revealed in earnings announcement, we first focus on exploring the information motivation and build an analysis relative to the earnings announcement date. In particular, we expect insider trading to be more positively related to actual repurchase before the earnings announcement than after the earnings announcement.

To prevent an overlap between announcements, we consider 2 months prior and 1 month after the earnings announcement (henceforth, the pre- and the postannouncement periods, respectively). We divide the preannouncement period into (calendar) Days -60 to -31 relative to the earnings announcement and Days -30 to -1 relative to the earnings announcement. The postannouncement period we consider is Days $1-30$ after the earnings announcement.

In constructing the sample for this analysis, in order to make a reasonable comparison, for each of the earnings announcement events, we require the firm to have insider activity during one of these periods. Thus, if a firm had no insider activity during period -60 to 30 relative to the earnings announcement, we remove this announcement event from the analysis (to reduce noise). As a result, from the 10,434 announcement–firm events analyzed in Tables VII and VIII, we are left with 3,349 announcement–firm events.

There is one point worth noting here. We find that the vast majority of insider trades are sell rather than buy trades. For example, during the period -60 and -31 , we observe only 4.5% buy trades. This is consistent with

Level 1 insiders having a significant portion of their compensation in the form of options and shares that vest on a regular basis and often engage in a predetermined selling program (e.g., Brisley, 2006). Accordingly, because most insider trades are sells; henceforth, when discussing our findings about the variability in insider trades the terminology we use is selling more versus selling less (rather than selling versus buying).

Table X reports regression results of the relation between insider trading and actual repurchase during pre- and postearnings announcement periods. Columns (1–4) and (5–6) report the pre- and postannouncement results, respectively. The dependent variable is the ratio of open-market insider trading of Level 1 insiders to outstanding shares accumulated over different time ranges relative to the earnings announcement. In each regression, insider trading is the net buy (buy less sell) during the relevant time period, normalized by the outstanding shares at the end of the previous quarter. Similarly to Table III, all coefficients are multiplied by 100 for ease of presentation. In all regressions, the main explanatory variable is the repurchase during the quarter *QRepYld*. We consider quarterly repurchase rather than monthly repurchase because the market response from which insiders could expect to benefit is based on the entire quarterly firm repurchase. This is because repurchase information is revealed to the public in the earnings, which are generally announced quarterly, whereas the monthly data are revealed only later when the financial report is submitted.

Regression (1) reports the relation between insider trading during the period (calendar) Days –60 to –31 prior to the quarter's earnings announcement and the repurchase during the quarter *QRepYld*. The period Day –60 to –31 prior to the earning announcement generally overlaps with the last month of the quarter. This is because most earnings announcements take place at the end of the 1st month after the end of the quarter. As Regression (1) shows, insider trading in this period is positively related to quarterly repurchase. This, in turn, suggests that in the last month of the quarter, the more the firm repurchases the less the insiders sell (the difference buy less sell of insider trading is more positive).

In Regression (2), we add controls for *PauseDum* (repurchase that follows a pause in repurchase) and *SUE* (surprise in analysts' forecasts) and show that the significance of *QRepYld* is unchanged. In Regressions (3) and (4), the dependent variable is insider trading during Days –30 to –1 relative to the earnings announcement. This is usually the 1st month after the quarter ends. As the results show, unlike in Regressions (1) and (2), in Regressions (3) and (4), the coefficient of *QRepYld* is close to zero and insignificant, indicating that insider trading is unrelated to repurchase activity during Days –30 to –1 relative to the earnings

Table X. Actual repurchase and insider trading during pre- and postearnings announcement periods

The table reports results from panel regressions of insider trading on actual repurchase and other explanatory variables, during pre- and postearnings announcement periods. To prevent an overlap between announcements, we define the periods as follows. For any earnings announcement event (as defined in Table VII), we look at 2 months prior and 1 month after the earnings announcement event, which adds up to a quarter period. We then divide the preannouncement period to Days -60 to -31 calendar days relative to the event (Regressions 1 and 2), and Days -30 to -1 calendar days relative to the event (Regressions 3 and 4). In a similar manner, we define the post announcement period as Days $1-30$ calendar days after the event (Regressions 5 and 6). In each specification, the dependent variable is the net buy (buy less sell) of insider trading during the relevant time period, normalized by the net outstanding shares at the end of the previous quarter (in percentage). The insider trading data are taken from Thomson Reuters, where we look at open-market trades made directly by the senior management (Level 1 classification in Thomson Reuters, e.g., CEO and chairman). From the 10,434 earnings announcement events, we are left with 3,349 events with nonzero insider activity during the pre- or the postperiods. *QRepYld* 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 (in percentage). *PauseDum* is a dummy variable, which receives the value of one in the 1st 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. *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. All regressions include time and firm dummy variables and the *t*-statistics are clustered by firm. All coefficients are multiplied by 100 for ease of presentation.

	Pre-ANN				Post-ANN	
	[-60, -31] (1)	[-60, -31] (2)	[-30, -1] (3)	[-30, -1] (4)	[1,30] (5)	[1,30] (6)
<i>QRepYld</i>	0.328 [2.34]	0.327 [2.32]	-0.017 [0.18]	0.014 [0.13]	-0.313 [1.30]	-0.342 [1.35]
<i>PauseDum</i>		0.011 [0.02]		-0.435 [0.89]		0.186 [0.18]
<i>SUE</i>		0.011 [0.91]		0.010 [0.58]		-0.008 [0.51]
<i>Adj-RSQ (%)</i>	2.66	3.31	0.26	0.15	1.04	1.28

announcement. When the insider trading considered is during Days $1-30$ after the earnings announcement [Regressions (5) and (6)], the relation between insider trading and repurchase during the quarter is even negative (although insignificant), suggesting insiders might reverse their trades relative to Days -60 to -31 .

Our interpretation of the findings in Table X is as follows. Close to the end of the quarter, in particular, during the last month of the quarter, insiders have private information about the firm's performance during the quarter. If this information is favorable, other things equal, they tend to sell less shares; if not, they tend to sell more shares. As a result, the coefficient of $QRepYld$ in Regressions (1) and (2) is positive. In the period after the quarter ends but before the earnings announcement (Days -30 to -1), insiders stop trading for their own portfolio based on private information they have about the firm's performance during the quarter. One reason could be insider trading rules. If insiders change their selling pattern too close to the announcement, they may be suspected of trading based on private information. As a result, their trade during this time period is not correlated with the firm's repurchases during the quarter, and hence the coefficient of $QRepYld$ in Regressions (3) and (4) is insignificant. Next, the earnings announcement takes place and the (private) information is revealed. Once the information setting is symmetric, insiders have no motivation to alter their stock sales in relation to repurchases during the previous quarter. As a result, the coefficient in Regressions (5) and (6) is even negative.³³

In an unreported analysis, we repeated the regressions in Table X replacing the dependent variable Level 1 insider trades with "all level" insider trades. That is, the dependent variable consists of Level 1 through 4 insider trades. In this analysis, repurchase trades were not significant in explaining insider trades. This result is natural as one would expect private information to weaken when going down the insider levels.

To test for the liquidity motivation, we considered monthly insider repurchases and monthly actual repurchases. Specifically, because we do not expect the liquidity motivation for repurchase and insider trade to be related to information release, we base our regressions here on calendar months. The dependent variable is insider trading (net buys) in the month, and the independent variable is monthly repurchases. We run regressions here with and without controlling for *PauseDum* and *SUE* as in Table X. In all regressions, monthly repurchase was not significant in explaining insider trades (results not tabulated). Results were unchanged when we aggregated the monthly insider trade and repurchase data into quarterly data and repeated the analysis. Thus, we do not find support for the liquidity motivation for insider trades.

To conclude, our findings in this section support the information motivation over the liquidity motivation. They suggest that insiders do not use

³³ Furthermore, in an unreported analysis, we find that the difference in insider trading before and after the earnings announcement is significant, suggesting the motivation to time the market after the information is out is reduced.

repurchases to provide liquidity for their personal trade. Rather, when insiders believe the stock is undervalued, they repurchase and buy more (or sell less) stock for their own portfolio; when they believe the stock is overvalued, they do not repurchase and buy less (or sell more) stock for their own portfolio. It is possible that insiders do not deliberately coordinate their trades with firm repurchases, but that private information affects their trade for their own portfolio and, separately, on the firm's behalf, and as a result a positive relation exists between repurchases and insider trading.

9. Conclusion

We use new data from SEC filings to investigate whether firms time their actual repurchase activity in the open market. The data set includes information about the monthly number of shares repurchased and their average monthly price. We provide evidence that repurchasing at discounted prices is related to both size and MB ratio. Specifically, we find that small and growth (high MB) firms repurchase at a price that is significantly lower than the average market price, whereas large and value (low MB) firms do not.

Small firms repurchase less frequently, suggesting that their repurchasing at more discounted prices is related to more strategic repurchasing. Although there is no significant difference in repurchase frequency between value and growth firms, we find that the ratio of repurchase to total payout (dividends plus repurchase) is significantly lower for value firms relative to growth firms and that repurchasing at discounted prices is positively related to this ratio. This, in turn, may suggest that value firms do not repurchase at discounted prices because they are less focused on timing the market in the first place.

Consistent with earlier investigations of quarterly repurchase data, we show that monthly repurchase activity is negatively related to past and contemporaneous returns. An important question, however, is whether actual repurchases are related to future returns. We find that it is the disclosure of quarterly repurchase information in earnings announcements that engenders this relation. Specifically, we find a positive and significant relation between repurchase activity during the quarter and the subsequent earnings-announcement return, which is followed by a significant drift. We show that this relation is also economically significant. A portfolio based on actual repurchase data and constructed around the earnings announcement earns an abnormal return of about 5.1% annually. Finally, we find that insider trading (net buys) and actual repurchases are positively related

during the pre-earnings announcement period. This, in turn, suggests that the relation between repurchase and insiders' trade is more likely information driven than liquidity driven.

The informational effects of actual repurchase that we find, in particular around the disclosure of repurchase activity in earnings announcements, suggest that regulators should consider tightening disclosure requirements, such as requiring firms to report their actual repurchases to the SEC in a more timely manner. We expect such requirements to result in more informative prices and to alleviate wealth expropriations from uninformed investors.

Appendix A

This Appendix contains an example of a report on 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

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 ^a	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 ^b
April 1–30, 2007	24,856,354	34.80	24,755,700	86 million
May 1–31, 2007	14,892,293	35.78	14,793,100	389 million
June 1–30, 2007	16,108,541	34.44	15,985,800	374 million
Total	55,857,188	34.96	55,534,600	374 million

^aAbout 322,588 shares were purchased on the open market to provide shares to participants in the Walt Disney Investment Plan and Employee Stock Purchase Plan. These purchases were not made pursuant to a publicly announced repurchase plan or program. ^bUnder a share repurchase program implemented effective from 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.

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