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Can Managers Time the Market? Evidence Using Repurchase Price Data

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Abstract

Little is known about the price firms pay for stock repurchases. Using a dataset of all U.S. repurchases from 2004 to 2011, we compare the actual average price paid monthly in a repurchase to the average market price for the same stock over various horizons. We find that firms repurchase stock at a significantly lower price than the average market price in all sample years. Less frequent repurchasers, firms that repurchase when insiders buy on their own account, and firms that experience low stock returns prior to the repurchase obtain significantly lower prices. After controlling for risk factors, repurchasing firms earn positive returns; infrequent repurchasers earn a significantly higher return up to three years following the actual repurchase.

1. Introduction

Can managers time the market in making security issuance and repurchasing decisions? This question has spurred many studies in both the security issuance and repurchases literatures. Despite numerous investigations, it remains unclear if the evidence supports or disputes the market timing hypothesis. Several papers present evidence in support of market timing but others dispute the interpretation of the evidence.[1] It is therefore unclear if firms are able to obtain significantly lower prices when they repurchase stock.

One of the reasons that it is difficult to determine whether managers can time the market in a repurchase is that much of this literature relies on long-run returns after the announcement event [Lakonishok and Vermaelen (1990), Ikenberry, Lakonishok and Vermaelen (1995), (2000a), (2000b), and Peyer and Vermaelen (2009)].[2] This evidence is particularly difficult to link to market timing because many firms announce but never actually repurchase stock [Stephens and Weisbach (1998)]. Other studies based on large scale U.S. data on repurchases show that firms repurchase after a stock price run-down [e.g., Jagannathan, Stephens, and Weisbach (2000)], but this analysis is based on annual or perhaps quarterly data on the amount of (but not the price paid for) stock repurchased. Further, several studies provide evidence that firms repurchase for reasons other than undervaluation [Dittmar (2000), Grullon and Michaely (2002), Jagannathan, Stephens, and Weisbach (2000), Kahle (2002), Bens, Nagar, Skinner, and Wong (2003), Massa, Rehman, and Vermaelen (2007)]. Understanding managers' ability to repurchase undervalued stock is vital to reconcile the academic studies of repurchases with the

[1] Baker and Wurgler (2000 and 2002), Ikenberry, Lakonishok, and Vermaelen (1995, 2000a and b), and Peyer and Vermaelen (2009) present evidence consistent with market timing, while Eckbo, Masulis, and Norli (2000), Schultz (2003), Butler, Grullon, and Weston (2005), and Dittmar and Dittmar (2008) dispute the interpretation of these findings as evidence of market timing.

[2] The evidence based on operating performance is similar to the long-run returns but more inconclusive. Lie (2005) shows that firms' operating profitability improves following a repurchase announcement, while Gong, Louis, and Sun (2008) show that this is due, at least in part, to pre-repurchase announcement downward earnings management.

fact that CFOs list undervaluation as the primary factor driving the motive to repurchase. Brav, Graham, Harvey, and Michaely (2005) conduct a survey of financial executives, and find that 86.4% of all firms agree or strongly agree with the supposition that firms repurchase when their stock is a good value, relative to its true value. Moreover, they find that about half of the interviewed CFOs say that their firm tracks repurchase timing and can beat the market, with some saying they can beat the market by $1 or $2 a share over the course of a year.

In this paper, we utilize monthly data of repurchase prices, available from 10-K and 10-Q filings on EDGAR, and the average stock price from CRSP before and after the repurchase to examine whether firms are able to time the market with repurchases. By utilizing these data, we are able to speak to both the ability of firms to time the market and the cross-sectional dispersion in firms' ability to repurchase at a low and possibly undervalued price. Our sample consists of 2,237 firms that repurchase stock as part of an open market stock repurchase program in a total of 38,900 firm-months between 2004 and 2011 and is an exhaustive list of stock repurchased within an open market repurchase program over this period. This paper is the first to examine the price paid in monthly U.S. stock repurchases for a full sample of repurchasing firms.

To measure market timing, we estimate a relative repurchase price by comparing the average reported monthly repurchase price to the average CRSP daily closing price for the same stock over the month of the repurchase and one-, three-, and six-month windows before and after the repurchase month. We predict that if firms can time the market, the relative repurchase price should be significantly less than zero. We find that the relative repurchase price is, on average, significantly less than zero: the average firm repurchases stock at a price significantly lower than the average closing price over the month of the repurchase and over the months surrounding the repurchase. Specifically, the median firm repurchases stock at a price that is 1.8% lower than the average closing price six months before to six months after the repurchase.

Jagannathan, Stephens, and Weisbach (2000) show that firms repurchase after a stock price run-down. To distinguish our results from this previous finding and to better determine if firms can time the market, we repeat our analysis using a forward-looking relative repurchase price, which compares the average monthly repurchase price to the average CRSP daily closing price in the month of and months following the repurchase. We find similar results: the average firm repurchases stock at a price lower than the average closing price for the month of and one, three, and six months following the repurchase. The median firm repurchases stock at a price that is 2.3% lower than the average closing price in the month of and six months following the repurchase. We also examine post-repurchase returns by calculating the alpha from Fama and French (1993) calendar-time portfolios and examine this return over several investment horizons between three months and three years post-repurchase. We confirm that, on average, repurchasing firms earn superior returns after controlling for risk factors, but these superior returns vary in the cross-section.

Our sample spans before, during, and after the financial crisis. Aggregate repurchases fluctuated greatly during this time, peaking in 2007 and reaching a low in 2009. Given fluctuations in stock prices over this time, we may expect the ability of firms to repurchase at a low price to be correlated with the aggregate market. When we examine how the relative repurchase price varies over time, we find that, on average, firms buy at prices significantly lower than the average closing price in all calendar years. The relative price paid is highest in 2007 and 2008 and lowest in 2009, corresponding to the years firms repurchased more and less stock, respectively. To further investigate if firms time the aggregate market, we examine the correlation between the relative repurchase price and the market return in the six months prior to the repurchase, controlling for other factors. We find that firms pay a lower relative repurchase

price following a market downturn, suggesting that managers time the aggregate market as well as the price of their own stock.

In addition to the repurchase price, we also observe detailed information on the amount and timing of repurchase activity using a monthly window, which is much narrower than that used in other U.S. studies. We therefore examine the frequency of repurchase activity and find that the frequency of repurchase activity varies considerably, with 20% of firms repurchasing stock in at least nine months of a calendar year. We find that frequent and infrequent repurchasers differ significantly in several ways: frequent repurchasers are significantly larger, more profitable, and have significantly higher dividend payouts. Frequent repurchasers also have a significantly higher market-to-book ratio, lower volatility, and lower bid-ask spread. Moreover, though the fraction of stock repurchased in one month is smaller for frequent repurchasers, the median frequent repurchasers repurchase 4.6% of their market value over a calendar year (compared with 1.2% for infrequent repurchasers), accounting for over 58% of aggregate repurchases. These differences suggest that the motives for repurchasing and the potential role of market timing may differ for frequent and infrequent repurchasers.

We find that firms' ability to time the market is decreasing in the frequency of repurchase activity. Firms repurchasing only once in a year pay an average 8.2% discount relative to the average CRSP price over six months before and after the repurchase (measured over the month of and six months after the repurchase, the average discount is 3.2%). The average price paid by monthly repurchasers is not significantly different from the average market price for the stock. This evidence suggests that frequent repurchasers are likely repurchasing stock for reasons other than misvaluation and is particularly interesting given that frequent repurchasers are large firms that repurchase the highest fraction of their market value in the course of the year. For more

moderate repurchasers, we find that the relative repurchase price is significantly negative, but much less than the infrequent repurchasers.

We confirm these results in a multivariate analysis. Specifically, we regress the relative repurchase price on an indicator for repurchase frequency, prior market return, firm characteristics, and year and firm fixed effects. Compared to moderate repurchasers, infrequent repurchasers (four or fewer months in a year) pay a significantly lower price, while frequent repurchasers (nine or more months a year) pay a significantly higher price. Compared to the six month comparison period surrounding the repurchase, infrequent (frequent) repurchasers repurchase stock at 2.2% less (0.6% more) than moderate repurchasers. Compared to the six months period after the repurchase, infrequent repurchasers repurchase stock at a relative price 2% less than moderate repurchasers. Our evidence thus suggests that some managers do time repurchases relative to their firms' own stock price.

If managers are timing the market through firm stock repurchases, we might expect insider purchases to coincide with firm repurchases, particularly those purchased at a discount. Seyhun (1986) provides evidence of managers' ability to time the market with their personal trades. Thus, similar to Jenter (2005), we use insider buying net of insider selling as an indicator that a firm is potentially misvalued. Our evidence is consistent with managers' ability to time the market: repurchasing firms with relatively high net insider buying have significantly lower relative repurchase prices. These differences persist after controlling for repurchasing frequency and firm characteristics. However, these results are considerably stronger using the before and after rather than the forward-looking comparison periods.

The relation between the relative repurchase price and insider net purchases raises the question of whether managers have proprietary information about the firm's future prospects or managers use repurchases as a response to market overreaction of bad news. Peyer and

Vermaelen (2009) find support for the hypothesis that managers use repurchases to respond to market overreaction of bad news. Specifically, they find that firms that were "beaten up" the most prior to the repurchase announcement experience the highest long-run abnormal returns post-announcement. Peyer and Vermaelen (2009) show that small firms with a low M/B ratio, a low six-month prior return, and a stated motivation for the repurchase being due to "undervaluation" or "best use of money" are most likely undervalued. Moreover, they argue that analysts are at least partially responsible for the decline in stock price. If managers repurchase shares in response to market overvaluation brought about by pessimistic analysts, we would expect a lower relative repurchase price for ex-ante undervalued firms and for those with negative analyst views.

We find some evidence consistent with the results of Peyer and Vermaelen (2009). Managers of smaller firms, firms with poor prior stock returns, and a low market-to-book ratio, repurchase at a lower relative price. To further test if information known to the market and potential overreaction to this information drives firms to be able to repurchase at a lower price, we examine several additional variables. Specifically, we examine whether firms with more downgrades, less analyst following, more EPS forecast dispersion, a drop in forecasted EPS, and a stated repurchase motivation due to undervaluation are able to obtain lower prices in a repurchase. We find little evidence that these measures impact the relative repurchase price. Though firms obtain lower prices after a period of low returns, market news or perceptions about the firm does not lead to a lower relative repurchase price, suggesting it is managerial private information driving our results.

This paper contributes to a vast literature on stock repurchases and the ability of firms to time the market when they repurchase stock. Most similar to this paper are Brockman and Chung (2001), Cook, Krigman, and Leach (2004), and Ben-Rephael, Oded, and Wohl (2014).

Brockman and Chung examine the timing ability of approximately 190 repurchasing firms in Hong Kong, while Cook, Krigman, and Leach pursue a similar research agenda using 64 U.S. firms repurchase trading data. Both papers find that, on average, managers are able to time the market. However, Brockman and Chung find that approximately half the managers are able to beat a naïve investment strategy and that their repurchases impact trading behavior, while Cook, Krigman, and Leach find little cross-sectional variation in the ability to time the market or an impact on trading. In a concurrent paper, Ben-Rephael, Oded, and Wohl (2014) utilize similar price data to that used in this paper but for only 620 U.S. firms and also find evidence consistent with market timing. Further, Ikenberry, Lakonishok, and Vermaelen (2000b) examine repurchases for firms in Canada using monthly repurchase volume, but not price, data and find evidence of market timing. Bonaimé, Hankins, and Jordan (2014) examine the average stock price of firms in the quarter they repurchased (using average CRSP prices, not the average repurchase price) and compare this to the quarters they did not repurchase and find the prices are higher in the quarter of the repurchase. Our paper extends prior research by examining the price paid in a stock repurchase for a full sample of all U.S. repurchasing firms over several years, thus allowing a more complete analysis and a greater ability to examine cross-sectional variation in timing.

In section 2, we describe the sample and data collection. Section 3 discusses and presents evidence on the relative repurchase price. In section 4, we use a multivariate setting to examine the cross-sectional variation in timing. Section 5 reports Fama-French regressions, controlling for market risk factors, to further examine timing ability. Section 6 concludes the paper.

2. Data and methodology

In 2003, the SEC amended Exchange Act Rule 10b-18, requiring companies to disclose all repurchases in their annual and quarterly reports as of March 15, 2004. As a result, at the end of each fiscal quarter, firms are now required to disclose the number of shares repurchased each month, the average price paid for repurchases over the month, and whether the shares were repurchased as part of a public plan. We utilize these data to speak both to the ability of firms to time the market and the cross-sectional dispersion in firms' ability to repurchase at a low and possibly undervalued price. This paper is the first to examine the full sample of repurchasing firms using these data.[3]

To construct our sample, we utilize Perl to search 10-K and 10-Q filings on EDGAR to identify firms conducting repurchases from 2004 through 2011. To ensure we have captured all repurchases, we also use the purchases of stock variable from the Statement of Cash Flows from Compustat to identify repurchasing firms over the period. For any firms not identified in the Perl search but identified by Compustat as having purchased stock, we manually search all 10-K and 10-Q filings on EDGAR to determine whether the firm repurchased stock. For all repurchasing firms identified by Perl or Compustat, we hand collect data on the amount repurchased, the average price paid for each month, and whether the repurchase was part of an open market repurchase program from the SEC filing for each month. If a firm repurchases in any month in our sample, we hand collect repurchase data for all months in our sample period.

[3] Banyi, Dyl, and Kahle (2008) provide summary statistics of the amount repurchased by a random sample of 520 firms in 2004 using these data (to determine the accuracy of previously used measures of the quantity of stock repurchased), and Ben-Rephael, Oded, and Wohl (2014) examine a subset of 620 firms (approximately 25% of the total number of repurchasing firms). However, no other paper utilizes data on both the amount and price of a full sample repurchasing firms. Thus, we are able to provide insight on the average repurchaser using the full population as well as the cross sectional variation that is not biased by sample selection.

By employing data from the 10-Q and 10-K filings, SDC announcement data, and data on accelerated repurchases from Bargeron, Kulchania, and Thomas (2011)[4], we exclude repurchases that are part of an accelerated repurchase program, tender offer, or privately negotiated repurchase. We also exclude firms for which Compustat data are not available for the fiscal year prior to the repurchase. Using these methods, we identify 2,237 firms that have repurchased at least once during 2004-2011 as part of a publicly-announced open market stock repurchase program. Our final sample includes these 2,237 firms over 7,496 unique firm-years, encompassing 154,391 firm-months, of which 38,900 are firm-months with repurchases.

Table 1 provides summary statistics of repurchase activity for the sample. As shown in the table, the frequency of repurchase activity varies considerably across years. The largest number of firms repurchasing occurred in 2008, while 2007 saw the largest aggregate value of repurchases. The year with the lowest number of repurchasing firms and smallest aggregate value repurchased was 2009. We find that about half of firms repurchase infrequently, four or fewer times during the year. Perhaps more surprisingly, almost 20% of repurchasing firms repurchase frequently, at least nine times a year. Indeed, frequent repurchasers account for 58% of the aggregate dollar value of repurchases, compared to 23% for moderate and 19% for infrequent repurchasers.

Panel A of Table 2 presents summary statistics of firm characteristics for the full sample and for subsamples based upon repurchase frequency. Frequent and infrequent repurchasers differ significantly on many dimensions. Frequent repurchasers are significantly larger and more profitable, with higher market-to-book and dividend payout ratios than infrequent repurchasers. Frequent repurchasers also have a smaller bid-ask spread and lower volatility. Although frequent repurchasers buy back less on a monthly basis, as a fraction of market value, they tend to

[4] We thank Bargeron, Kulchania, and Thomas (2011) for providing their data on accelerated repurchases.

repurchase more over the entire year (although the difference in annual repurchases is significant only for the median). Specifically, although the median frequent repurchaser's monthly repurchase is 0.32% of market value (compared to 0.44% for infrequent repurchasers), the median frequent repurchaser repurchases 4.57% of the firm's market value on an annual basis (compared to 1.19% for infrequent repurchasers). These differences suggest that the motives for repurchasing, and the potential role of market timing, may differ for frequent and infrequent repurchasers. Before we investigate these differences, we first examine the extent to which managers, on average, are able to time the market.

3. Relative repurchase price

Unlike prior research on repurchases by U.S. firms, which relies on long-run returns after the announcement of the repurchase to determine whether managers are timing the market, in this paper, we observe and examine the average price paid for actual repurchases each month. Thus, we are able to more directly measure whether firms implement repurchases to time the market. To measure managers' ability to time the market, we construct a measure that compares the average price paid for repurchases during the month (as reported in the 10-Q and 10-K), $\overline{\overline{REP}}_0$, to the average daily closing stock prices (from CRSP) over several comparison periods of *t* months before and after the repurchase month, $\overline{\overline{CP}}_{\pm t}$. If managers are not timing the market, we would expect the average price paid to be insignificantly different from the average CRSP price from surrounding month(s). Conversely, if a manager is able to time the market, conditional on deciding to repurchase in a given time period, we would expect the firm to pay a price that is significantly lower than the average price a typical investor would pay (that is, $\overline{\overline{REP}}_0 < \overline{\overline{CP}}_{\pm t}$). We measure market timing as the percentage difference between the average price paid for

repurchases, $\overline{\overline{REP}}_0$, and the average CRSP closing price, $\overline{\overline{CP}}_{\pm t}$, measured *t* months surrounding the repurchase. We refer to this variable throughout the paper as the *Relative Repurchase Price*:

$$\text{Relative Repurchase Price}_{\pm t} = \frac{\overline{\overline{REP}}_0}{\overline{\overline{CP}}_{\pm t}} - 1 \quad (1)$$

where $\overline{\overline{REP}}_0$ is the average repurchase price paid in the repurchase during the repurchase month (as reported in the financial statements) and $\overline{\overline{CP}}_{\pm t}$ is the comparison price measured during *t* months before and after the repurchase. If firms can time the market, we posit that the relative repurchase price should be significantly less than zero.

Because managers choose in which months to repurchase, we estimate the relative repurchase price comparing the average repurchase price to the average daily closing CRSP price during the repurchase month (t=0), as well over one-, three- and six-month windows before and after the repurchase month. If the manager is timing the market, we expect he will not only buy at a low price relative to historical prices but also at a price lower than his forecast of future prices. Thus, we compare the repurchase price to the average closing price in the months before and after the repurchase to gain insight into a manager's ability to time the market.

The rationale for this balanced measure is that firms are looking at windows for when to repurchase and, if they are timing the market, managers will choose to repurchase when prices are low within that window. However, if a manager can time the market, he should be able to look forward as well as back. Indeed, much of the long-run performance literature examines prices after the announcement. Therefore, we also examine a forward-looking relative repurchase price. Specifically, we recalculate equation (1), replacing the comparison price (CP) with the average of CRSP closing prices measured the month of and t months *after* the repurchase, where "t" is one, three, or six months following the repurchase month. In other words, we exclude the

pre-repurchase month(s) portion of the comparison period and note this by removing the "–" sign in the time indicator.

$$\text{Relative Repurchase Price}_{0,+t} = \frac{\overline{\overline{REP}}_0}{\overline{\overline{CP}}_{0,+t}} - 1 \tag{2}$$

In addition to using the Relative Repurchase Price over various comparison periods, we also examine post-repurchase long-run returns using Fama-French (1993) calendar-time portfolio regressions. We implement these regressions over three-month, six-month, and one-, two- and three-year windows. We present these results in Section 5.

Table 3 provides summary statistics on the relative repurchase price for all comparison periods. Specifically, for the full sample and for each sample year, we present results relative to the month of repurchase, for one-, three-, and six- months before and after the repurchase, and the month of repurchase plus one, three, and six months afterwards. We find that the average (median) relative repurchase prices for the full sample are significantly negative for all comparison periods, thus indicating that the average (median) firm is able to time the market. On average, firms repurchase at a price that is 0.76% lower than the average daily closing price for that firm during the same month. Moreover, the relative repurchase price is significantly negative for all comparison periods we examine, suggesting that managers not only time the days in the month which they repurchase, but they also choose to repurchase when the price is low relative to longer horizons (of up to six months). Specifically, the median firm repurchases at a price that is 0.86%, 1.37%, and 1.77% lower than the average firm price in the one-, three-, and six-month periods before and after the repurchase month, and 0.88%, 1.50%, and 2.34% lower in the month of and one-, three-, and six-month periods after the repurchase month.

Though the average and median firm repurchases at a discount, there is considerable cross-sectional dispersion in the discount. Panel B of Table 2 summarizes differences in firm

characteristics for those that repurchase *mostly* at a discount, thus providing insight into which firms are able to consistently time the market. Specifically, we divide the sample into two groups: firms that have repurchased at a discount for at least 75% of their repurchases in a given year and those that do not repurchase primarily at a discount. We find that firms repurchasing mostly at a discount are significantly smaller and less profitable, have slightly higher cash-to-assets (significant only at the median and only at ten percent), slightly lower dividend payout ratios (significant only at the mean and at ten percent), and have significantly higher bid-ask spreads and stock price volatility. Firms repurchasing mostly at a discount also tend to repurchase less both on a monthly and annual basis (differences significant only in the median).

The average and median relative repurchase price also varies over time. Table 3 provides insight into how the discount varies over time, while Panel A of Figure 1 depicts both the annual average discount and the annual aggregate repurchases over time. Table 3 shows that the median firm repurchases stock at a discount in all calendar years except 2007 and 2008. The median degree of potential timing peaks in 2009 at –4.67% (–9.36%) for the six month before and after comparison window and is a low point (i.e., firms pay a higher price on average) in 2007, at 0.30%. Using the forward looking comparison periods, firms repurchase at a significant *premium* in 2007 and 2008, with firms in 2008 paying a median 8.4% premium relative to the month of and six months after the repurchase. Comparing the average relative repurchase price to aggregate repurchase volume, Panel A of Figure 1 illustrates that firms pay a *higher* relative repurchase price in the years that firms repurchase more stock in aggregate. If firms are paying a higher price in some years, we may expect these repurchases to be followed by lower long-run returns. In Panel B of Figure 1, we therefore examine the three-year buy and abnormal returns by

calendar year of the repurchase.[5] This figure mirrors Panel A showing that in years when firms pay a higher relative price, they earn lower three-year buy-and-hold abnormal returns. This correlation suggests that, for some firms, factors other than market timing drive stock repurchases.

The time-series trends in relative repurchase price also provide insights into whether firms time misvaluations in their stock's price or simply time aggregate market movements. To shed light on this issue, we compare the annual market returns for each year in our sample period (2004-2011) to the value-weighted CRSP average annual return for the 1980-2011 period. Four calendar years in our sample period (2005, 2007, 2008 and 2011) had a lower market return than the long-run average annual CRSP market return. Notably, these years correspond to years where aggregate repurchases and relative repurchase prices are moderate to high relative to other sample years. These correlations imply that firms are not timing the aggregate market when making repurchase decisions. In later analysis, we directly test for the impact of prior market return on the repurchase price, while controlling for year fixed effects.

As shown in Table 1, approximately 20% of all firm years and 59% of aggregate repurchases are by frequent repurchasers (those repurchasing at least nine times a year). We conjecture that repurchase frequency may affect a manager's ability to time the market. Specifically, firms that repurchase once a year have more flexibility in terms of timing than do firms that repurchase monthly.[6] Thus, in Table 4, we examine how the frequency of repurchases relates to the relative repurchase price. We find that the repurchase price is monotonically decreasing in repurchase frequency, regardless of comparison window. In fact, the difference in

[5] Panel B presents the average three-year buy-and-hold abnormal returns, by annual cohort, relative to 25 size and B/M matched portfolios obtained from Kenneth French's website. In Table 11, as discussed in section 5, we examine long-run returns using Fama-French calendar time regressions to test whether firms earn significant excess returns. Due to econometric constraints, we are unable to break the calendar time regressions into annual cohorts and thus present buy and hold returns here for illustrative purposes.

[6] Of course, repurchases may impact prices and thus frequency of repurchasing. In section 4, we examine and control for the potential impact of price support.

the relative repurchase price of infrequent versus moderate or frequent repurchasers is quite large. Using the six month before and after comparison window, we find that firms repurchasing just once during the year have an average (median) repurchase price of –8.19% (–7.25%) compared to an insignificant –0.02% (+0.11%) for monthly repurchasers. Comparing infrequent repurchasers (those that repurchase four or fewer times a year) to frequent repurchasers (those repurchasing at least nine times a year), we find a significant average (median) difference of -5.87% (-5.14%). Similar differences exist between infrequent and frequent repurchasers for all comparison periods. Further, as shown in the bottom panel, the difference in relative repurchase price for frequent and infrequent repurchasers increases monotonically as the measurement window increases.

Table 4 shows that frequent repurchasers pay significantly higher prices than infrequent repurchasers. In fact, in untabulated tests, we find that the relative repurchase price of infrequent repurchasers is significantly lower than moderate repurchasers as well. This evidence suggests that while many firms pay significantly lower prices than a random investor, consistent with market timing, the effect is particularly strong for firms that repurchase infrequently. Of course, these are univariate tests, which do not control for firm characteristics and as shown in Table 2, there are significant differences between frequent and infrequent repurchasers. In the next section, therefore, we model the relative repurchase price in a multivariate setting in which we control for firm characteristics.

4. Cross-sectional variation in the relative repurchase price

In Table 5, we present regressions of the relative repurchase price on repurchase frequency and firm characteristics, including year and firm fixed effects. The dependent variable is the relative repurchase price, measured over six comparison periods: for one-, three- and six-month periods before and after the repurchase and for the month of and one, three, and six

months after the repurchase. We include two variables to capture repurchase frequency: "infrequent repurchaser" is an indicator variable equal to one for firms that repurchase one to four times a year, and "frequent repurchaser" is an indicator variable equal to one for firms that repurchase at least nine times a year. To determine the impact of aggregate market timing, we include the CRSP market return for the period six months prior through the repurchase month. We use the pre-repurchase period for the aggregate market return since we assume managers may be able to time the aggregate market by repurchasing following a decline but are less able to predict future market movements.

We find that, regardless of the event window we employ, infrequent repurchasers obtain a significantly lower relative repurchase price than do moderate repurchasers (the excluded group), consistent with the univariate results presented in Table 4. Indeed, the relative repurchase price is two percent lower for infrequent repurchasers using either the six month before and after, or the month of and six month after, comparison window. Further, frequent repurchasers pay a significantly higher relative repurchase price for all before and after comparison periods, as well as for the month of and one month after comparison period.

Focusing on firm characteristics, we find that more volatile firms pay a lower relative repurchase price. For most comparison windows, particularly those excluding months prior to the repurchase, we find that smaller firms, firms with a lower market-to-book ratio, and firms with a higher cash-to-assets ratio attain a lower relative repurchase price, indicating that these firms are more likely to be timing the market. For all comparison periods, we find that the coefficient on the six month prior market return is negative and significant, suggesting that firms pay a lower relative repurchase price following market declines. This evidence suggests that managers time both their own stock as well as the aggregate market, repurchasing at lower prices when prior aggregate market returns have been lower.

The analysis in Table 5 includes firm and year fixed effects. In untabulated tests, we perform an F-test on the firm fixed effects and find that, collectively, firm fixed effects are significantly different from zero, indicating that some firms consistently pay higher or lower relative prices. Further, several of the year fixed effects are significant. Specifically, relative to the 2004 excluded year, firms paid a higher relative price in 2006, 2007, and 2008, regardless of the comparison window used.

Overall, the results in Table 5 suggest that infrequent repurchasers time the market, while frequent repurchasers may have alternative motives to repurchase other than misvaluation. Also, Table 5 shows that smaller firms, firms with lower a market-to-book ratio, firms with more volatile stock, and firms with higher cash-to-assets are more likely to time the market. Given that both the univariate and multivariate evidence suggest that many firms are able to time the market, a natural question is, "If managers can time the market, do they do so on their own account?" Thus, we next turn our attention to the relation between the relative repurchase price and the frequency with which insiders conduct purchases on their own account.

4.1. Insider trading activity

To further examine the cross-sectional variation in firms' ability to time the market, we examine insider trading behavior for firms repurchasing during the same month. Seyhun (1986) provides evidence of managers' ability to time the market with their personal trades. Thus, similar to Jenter (2005), we use insider buying (selling) as an indicator that a firm is potentially misvalued. In doing so, we are able to confirm whether our relative repurchase price measure is lower when insiders view the firm as undervalued, providing further insight into whether firms are able to time the market.

Information on insider trading is obtained from the Insider Filing Data Feed, available through Thomson Reuters. This database captures all U.S. insider trading activity as reported on

Forms 3, 4, 5, and 144. For our full sample of 38,900 repurchases during the 2004-2011 period, we search for insider trades occurring in the same month. We find 17,622 repurchase months where insiders are also trading. In Table 6, we divide our sample firms into quartiles based on the insider buying over the same periods that the relative repurchase price is measured. We measure net insider buying as insider buys minus insider sells for each month, scaled by shares outstanding at the end of the prior quarter. We then sort firms into quartiles based upon this net insider buying measure.[7] For each quartile of insider buying, we summarize the relative repurchase price paid by the firm.

As shown in Table 6, for most insider trading quartiles and comparison periods, firms repurchase at significantly less than the average CRSP closing price. However, for firms in the lowest quartiles (with less insider buying), the relative repurchase price is significantly positive for the six month window before/after the repurchase month, indicating that when insiders buy less (or sell more) on their own account, firms repurchase at a premium as opposed to a discount using this longer window surrounding the repurchase.

We conjecture that, if managers can time the market, the firm should pay a lower relative repurchase price when insiders are buying more on their own account. Thus, we examine the average (median) difference in relative repurchase price of the two extreme quartiles of net insider buying. For the comparison windows surrounding the repurchase, we find that, consistent with expectations, firms with more insider buying tend to repurchase at lower prices than those with less insider buying. However, for the comparison windows excluding months prior to the repurchase, the findings are exactly opposite: firms with less insider buying repurchase at a lower price. We posit that these results may be due to correlation between insider trading and

[7] Quartile 1 has net insider buying of –0.005 (thus more selling than buying) and Quartile 4 has net insider buying of 0.001.

firm characteristics. Thus, in Table 7, we further examine the correlation between insider trades and the relative repurchase price in a multivariate setting.[8]

In Table 7, we repeat the analysis presented in Table 5, including an indicator variable for the quartile of net insider buying used in Table 6. Table 7 shows that for all comparison windows, firms pay a lower price when there is more insider buying. This result confirms our conjecture that firms repurchase at a lower price when insiders are net buyers and hence, the stock is more likely undervalued.

Table 7 also shows that, after controlling for net insider buying, we continue to find that infrequent repurchasers obtain a significantly lower repurchase price over each comparison window. Similar to Table 5, the evidence of frequent repurchasers is mixed, with the coefficient on the frequent repurchase dummy being significantly positive in the before and after comparison periods but not significant in the after comparison periods. We continue to find that firms with more volatile stocks and those that repurchase following market declines obtain a significantly lower relative repurchase price. We also continue to find that smaller firms with lower market-to-book ratios obtain a significantly lower relative repurchase price in the after comparison window. These results provide evidence that some firms are able time the market using open market repurchases and offer insights into which firms time the market.

4.2. Announcement returns

Our results thus far demonstrate that firms repurchasing infrequently time their repurchases to obtain a lower repurchase price and that this timing coincides with more insider

[8]Several papers examine the correlation between insider trades and firm repurchases as well as how announcement and long-run returns vary based on insider trading behavior [Lee, Mikkelson, and Partch (1992), Chan, Ikenberry and Lee (2003), Louis, Sun, and White (2010), Babenko, Tserlukevich, and Vedrashko (2011), and Bonaimé and Ryngaert (2013)]. These papers provide mixed evidence of the related timing of insider buying and firm repurchases as well as the impact of long-run returns.

buying. In this section, we examine returns surrounding announcements of repurchase programs to investigate whether investors anticipate firms' timing through repurchases. Thus, for the 2,237 firms that repurchase stock in 38,900 firm-months over our 2004-2011 sample period, we search SDC for repurchase announcements back to January 1, 2000. Since repurchase programs are often approved for up to four years, we search for repurchase program announcements up to four and a half years prior to repurchase. We also search Factiva for the news announcement to get a clean measure of the repurchase announcement return, and we exclude any repurchase announcements that have concurrent earnings or dividends announcements. Using this procedure, we are able to find and match announcement dates for 2,921 unique repurchase announcements associated with 20,840 monthly repurchases. These announcements occur on average (at the median) 15 months (ten months) prior to the repurchase.[9]

For our sample, the average three-day cumulative announcement return is 1.87% (not tabulated), which is consistent with prior evidence, given the majority of the announcements are open market stock repurchases [Vermaelen (1984), Comment and Jarrell (1991), Ikenberry et al. (1995), and Grullon and Michaely (2002)]. To examine the variation in announcement CARs, we categorize firms into quartiles based upon their announcement returns in Table 8. We find substantial variation in CARs, with the lowest quartile having an average (median) three-day abnormal return of –5.28% (–2.94%), and the highest quartile having an average abnormal return of 9.68% (7.38%).

Previous research investigates why open market repurchases have a positive announcement return despite the fact that there is no guarantee of an actual repurchase and, thus, no cost to providing the signal. Ikenberry and Vermaelen (1996) model the option value of the repurchase

[9] Of the monthly repurchases in our sample with an announcement date, the repurchase month is within three, six, or 12 months of the repurchase announcement in 20%, 35%, or 57% of the observations, respectively. In 21.1% of the observations, the announcement is longer than one but less than two years from the announcement. In the remaining 22% of the repurchasing firm-months, the repurchase takes place at least two years after the announcement.

program, and Oded (2005) and Bhattacharya and Jacobsen (2013) develop signaling models in the absence of a signaling cost for repurchases. Peyer and Vermaelen (2009) note that if managers care about their reputation, lying is not a costless activity. To shed light on whether the announcement CAR in open market repurchases serves as a signal of potential mispricing, we examine the relation between the announcement CAR and our relative repurchase price measure, which captures the manager's ability to actually garner any remaining undervaluation with subsequent repurchases. The rightmost columns of Table 8 present mean and median relative repurchase prices for firms divided by announcement return quartiles over various comparison windows.

If investors can anticipate firms' timing through repurchase announcements, we would expect firms repurchasing to signal undervaluation would have a positive and higher CAR at the repurchase announcement. Moreover, if the announcement corrects for mispricing, we would not expect any variation in the relative repurchase price across CAR quartiles. Alternatively, if firms remain substantially undervalued after the announcement, and the degree of post-announcement mispricing is correlated with the degree of pre-announcement mispricing (as assumed in the long-run performance literature), then we would expect firms with the lowest announcement returns to be those that also repurchase at the lowest relative price. But, if a lower announcement CAR results from a smaller market reaction for a given level of misvaluation (or perhaps a more severe underreaction), then we may expect a negative correlation. Thus, the correlation between the announcement CAR and the relative repurchase price may be positive or negative.

As shown in Table 8, the average and median relative repurchase prices are negative and significant in all quartiles and using all comparison windows, with the exception of the Quartile 4 mean for the six month after comparison window. More importantly, we find no significant differences in relative repurchase prices for firms in the high and low CAR quartiles.

These results suggest that the information revealed at the announcement is not correlated with managers' ability to time the actual repurchase.

4.3. Stated motivation to repurchase

Peyer and Vermaelen (2009) propose that the stated motivation in the firm's repurchase announcement may be an indicator of potential undervaluation. Indeed, both Peyer and Vermaelen (2009) and Akyol and Foo (2013) find that the abnormal announcement return is higher for firms indicating undervaluation. Peyer and Vermaelen (2009) also find significantly positive long-run returns for firms indicating undervaluation at announcement. Thus, to further examine the impact of potential undervaluation on the relative repurchase price and the information revealed at the repurchase announcement, we divide the sample based on the stated motivation of the repurchase in the announcement. Specifically, we search news articles in Factiva for the 2,921 repurchase announcements, and from the announcements we note the repurchase motivation using the criteria defined in Peyer and Vermaelen (2009). We group all firms for whom the stated motivation for the repurchase was due to undervaluation or was the "best use" of the firm's funds as those indicating undervaluation as their repurchase motivation. All other repurchase announcements, including those where no motive is given, are considered as having no mention of value.

Consistent with Peyer and Vermaelen (2009), in Panel A of Table 9 we find that firms announcing a repurchase program because the stock is undervalued have significantly positive announcement returns. Moreover, the median announcement return is significantly higher for firms mentioning undervaluation in the announcement (no significant difference in mean returns). This evidence is consistent with the market believing the stated motivation.

In Panel B, we examine how the relative repurchase price varies based upon the stated motivation. If firms accurately state their repurchase motivation and are correct about their

valuation, then we would expect those firms that say that they are undervalued to obtain a lower relative repurchase price if the market does not correct for this information at the announcement. We find evidence consistent with this prediction: firms that announce they are undervalued pay a slightly, but statistically lower, relative repurchase price using the before and after comparison window. However, the result does not hold using the forward-looking windows. This evidence suggests that managers who announce that their firm is undervalued are able to time the market when they repurchase but only based on past, rather than future, returns.

4.4. Market expectations and information asymmetry

In the prior section, we demonstrate that investors anticipate managers' ability to time the market through repurchases; thus, explaining the positive CAR and the ability to repurchase at a low price relative to past but not future prices. To further examine how the motives to repurchase impact the price paid in a repurchase and to better understand how available information impacts managers' ability to time stock repurchases, we next investigate the influence of information asymmetry and market expectations on the price paid in a repurchase.

We use two measures from IBES to capture information asymmetry: the number of analysts following the stock and the dispersion of the EPS forecast divided by the absolute value of the mean forecast in the most recent period reported prior to the repurchase month. Brennan, Jegadeesh, and Swaminathan (1993) find that stocks that are followed by many analysts react faster to common information than stocks followed by a few analysts. Krishnaswami and Subrahmanyam (1999) argue that disagreement among analysts is an indication of the lack of information about the firm. Thus, we expect information asymmetry to be decreasing in the number of analysts following the stock and increasing in the dispersion of analysts' forecasts. If firms with more information asymmetry are more likely mispriced, then we would expect

positive (negative) relation between the number of analysts (dispersion) and the relative repurchase price.

To measure market expectations, we build on Peyer and Vermaelen (2009) who find support for the hypothesis that managers use repurchases to respond to market overreaction of bad news. Specifically, they find that firms that were "beaten up" the most prior to the repurchase announcement experience the highest post-announcement long-run abnormal returns. Given this evidence, if managers use the repurchase in response to market overreaction of bad news, we would expect a positive relation between measures of firm undervaluation prior to the repurchase and the relative repurchase price.[10]

We examine three measures of the market's expectations for the firms. Following Peyer and Vermaelen (2009), we measure the change in average EPS forecast of all analysts following the repurchasing firm, measured from six months prior to the repurchase through the repurchase month. We also include the number of analysts who downgrade the stock in the quarter prior to the repurchase divided by the total number of recommendations. Data for both measures are from IBES. We use these variables to measure the extent to which analysts have announced negative views about the firm, possibly pushing the firm price downward. Peyer and Vermaelen (2009) argue that the overreaction hypothesis states that prior returns are the best predictors of long-term returns. Thus, we also include the six month buy and hold abnormal return prior to the actual repurchase. If market overreaction leads firms to be more undervalued and thus repurchase stock, then we expect positive (negative) relation between the change in EPS forecasts and prior returns (downgrades) and the relative repurchase price.

[10] All variables in Table 10 are measured in the period prior to the actual repurchase month. Peyer and Vermaelen (2009) focus their analysis on the long-run returns after the announcement and therefore measure these variables prior to the announcement. In untabulated tests, we repeat the analyses presented in Table 10 but measuring all variables, including the market expectations and information variables, in the period prior to the announcement. Using this alternative measurement period does not substantially alter the interpretation of the results, though the significance of several coefficients weakens.

We examine all five of these variables in the multivariate analysis presented in Table 10, as well as a dummy variable if the firm mentioned undervaluation as its motivation in the repurchase announcement. As before, we control for the market return prior to the repurchase, firm characteristics, and firm and year fixed effects. We also include the frequency dummies and insider buying quartiles. Because these regressions include market expectations and potential overreaction in the period prior to the repurchase, we include only the comparison periods from the repurchase month forward.[11]

We find that firms pay a lower relative repurchase price after a period of low firm abnormal returns, as evidenced by the positive and significant coefficient on prior six month returns. This evidence is consistent with Peyer and Vermaelen (2009) who show that firms have a higher long-run abnormal return following the announcement if the stock price decreased prior to the announcement. It is also consistent with Jagannathan, Stephens, and Weisbach (2000), which shows that firms repurchase more stock after a stock price run down. However, the other measures of market perception and information asymmetry are not significant. Using the three and six month post repurchase comparison period, there is moderate evidence that the firms that have a decrease in EPS repurchase at a lower relative price.[12] All other coefficients on the information and market perception variables are insignificant. This evidence illustrates that even though firms that state they are undervalued have a positive announcement return, there is no evidence that these firms repurchase at a lower price.

Importantly, the previously discussed results that infrequent repurchasers and (to a lesser extent) firms with more insider buying obtain significantly lower relative repurchase prices

[11] Results including the before and after comparison periods are available from the authors and are qualitatively similar to those presented for the repurchase month forward. The main difference is that the EPS forecast dispersion and percent analyst downgrades are significantly negative for some of the before and after comparison periods but not significant for any of the forward-looking comparison windows.

[12] The median change in EPS forecast is –0.01, thus those with lower changes in forecasts have large decreases in the forecast.

continue to hold. And other coefficients on firm controls are similar to previous results. Taken together, the results indicate that managers are able to repurchase at a lower price relative to both the past and future stock prices, particularly those that repurchase four or fewer times a year. However, the information used to do this is not evident in the market perception or publicly available information, thus implying firms repurchase stock using private information.

4.4. Sequence of repurchases since the repurchase announcement

The analysis thus far treats all repurchase months the same and does not distinguish based on the timing since the repurchase announcement. If our relative repurchase price does measure market timing, we would expect the firm to obtain a low price regardless of when the repurchase occurs. However, if the actual repurchase is a signal to the market that the firm does intend to repurchase, and if this information sends a positive signal to the market, then our relative repurchase price measure could be biased, impacted by this confirmation signal or other information announced with this information. Given that many firms that announce a repurchase never actually repurchase stock [Jagannathan, Stephens, and Weisbach (2000)], the potential for this confirmation signal or other information being released around this event is problematic.

If a confirmation signal is driving our results, we would expect our results to be less significant if we remove the first repurchase after the announcement from the analysis, since that first repurchase should convey the largest amount of information. We, therefore, repeat our analysis from Panel A of Table 10, removing the first repurchase after the announcement. These results are presented in Panel B of Table 10. We find that results in which the first repurchase is omitted are similar in significance and magnitude to those including the full sample, indicating that a confirmation signal is not driving our findings. We also repeat this analysis removing the first three repurchases (not presented) and find similar results.

In additional untabulated tests, we examine in more detail the variation in the relative repurchase price based on the time in months since the repurchase announcement. We find no monotonic change in the relative repurchase price across these timing measures. Further, in the next section, we examine the long-run returns for up to three years after the repurchase. If the effect we observe is a signal from the actual repurchase or other related information, we would not expect the effect to last for up to 36 months.

5. Controlling for market risk factors

In this paper, we show that firms that repurchase infrequently and have coinciding insider trades repurchase at historically low prices and ahead of price increases. However, our analysis thus far does not control for market risk. In this section, we examine post-repurchase returns utilizing Fama and French (1993) regressions, controlling for the three Fama-French (1993) factors: the market return minus the risk-free rate (RMRF), returns on a portfolio of small firms minus returns on a portfolio of big firms (SMB), and returns on a high book-to-market portfolio minus returns on a low BM portfolio (HML). Specifically, we estimate calendar-time portfolios as described in Kothari and Warner (2006) and utilized in Ikenberry, Lakonishok, and Vermaelen (2000). We examine portfolios over several time periods: three, six, 12, 24, and 36 months following the repurchase.[13] For the month of the repurchase, we estimate the return by comparing the repurchase price to the month-end closing price. All other monthly returns are calculated using monthly returns from CRSP. Portfolios are rebalanced monthly, calculating an

[13] For each calendar month of the sample period, we construct a portfolio comprising all firms making a repurchase within the prior three, six, 12, 24, or 36 months. To do this, we add firms to the portfolio in the month that they repurchase stock, and the stock is retained in the portfolio for three, six, 12, 24, or 36 months. Portfolios are rebalanced each month and an equal-weighted portfolio excess return is calculated. The resulting time series of monthly excess returns is regressed on the three Fama-French (1993) factors: the market return minus the risk-free rate (RMRF), returns on a portfolio of small firms minus returns on a portfolio of big firms (SMB), and returns on a high BM portfolio minus returns on a low BM portfolio (HML). The estimated intercept from the regression of portfolio returns is used as a measure of abnormal performance.

equal weighted excess return. The monthly returns are regressed on the three Fama-French factors as detailed in Fama and French (1993).

If managers have inside information and use this information to time the market, we predict positive long-run returns following repurchases (i.e., a positive and significant alpha). We estimate these regressions on the full sample, as well as on portfolios based on various subgroupings, to determine if these groups have significantly different performance. As shown in Panel A of Table 11, we find a positive alpha for all return horizons for the full sample. These results confirm prior evidence that managers time the market using repurchases. Next, we compare the alphas of various subgroups.

To examine the market-adjusted returns by repurchase frequency, we form a portfolio of infrequent repurchasers (those that repurchase one to four times per year) and a portfolio for frequent repurchasers (those that repurchase at least nine times a year). We present these results in Panel B of Table 11. We find that both portfolios exhibit significantly positive alphas over all horizons (from three months to three years). However, the portfolio of infrequent repurchasers significantly outperforms that of frequent repurchasers over all horizons, with an alpha on the difference between –0.3% and –0.6% per month. These results are consistent with our prior evidence demonstrating that firms which repurchase infrequently significantly outperform frequent repurchasers.

The results also shed insight into whether it is the manager or a dedicated broker timing the market, as some repurchasing firms have a dedicated broker that executes the trades. Though a broker may have backward-looking and short-term forward-looking insight, it is unlikely that a broker would have forward-looking insight three years ahead. Further, firms are more likely to employ a dedicated broker when they repurchase more frequently, while we find that firms that repurchase infrequently are those who tend to do so at more of a discount.

We also form portfolios of repurchasers with low insider net buys and high insider net buys, and we present these results in Panel C of Table 11. We find a significantly positive alpha for firms with high insider net buys for all horizons. Further, we find that the alpha for the low insider net buys portfolio is positive and significant in all but the three-month horizon. Although the low insider buy portfolio's alpha is always lower than the high insider buy portfolio's alpha, the difference in alphas is not significantly different from zero, except at the three month horizon, which is significant at the ten percent level. This evidence suggests that firms conducting repurchases corresponding with insider buying are only able to time the market over short horizons.

We next divide the portfolios by stated repurchase motivation. Recall that Panel B of Table 9 showed that firms stating they were repurchasing due to undervaluation had a significantly lower relative repurchase price using the before and after comparison period, but not for the month of and after repurchase periods. This result suggests that managers' stated motivation has more of a backward-looking than forward-looking insight. We find that, regardless of stated repurchase motivation, all alphas are positive and significant. Moreover, the alphas of the portfolios by stated motivation are not significantly different except at the three year horizon and, in the three year horizon, firms that stated they were undervalued have a lower alpha. These results confirm that the stated motivation does not reflect any forward looking insight.

In Panel E of Table 11, we divide the portfolio by prior six-month returns. Specifically, we form a portfolio of repurchases executed following a negative prior six-month firm return, versus those done following a positive prior six-month firm return. We find significantly positive alphas for both portfolios at all horizons, with one exception: the alpha for three-month returns is

negative for the portfolio of firms with prior positive six-month returns. The alphas for the two groups are not significantly different.

Overall, the long-run return evidence demonstrates that, on average, firms are able to time the market when they repurchase stock, and their ability to time the market varies primarily based upon the frequency of the repurchasing. These results suggest that some managers do time the market with repurchases and that the long-run performance can persist for up to three years.[14]

5.1 Price Support

Keswani, Yang, and Young (2007) document that during times when firms cannot repurchase, the price declines. The authors interpret this as evidence of price support. We, thus, examine our data for evidence of price support.

To determine whether firms repurchase for price support, we assume that less liquid firms are more likely to require price support. We use the bid-ask spread as a measure of the potential need for price support. We predict that if firms are repurchasing to support prices, they may be willing to do so at a premium and would not wait for a low price. Hence, if firms use repurchases to provide price support, we would expect less liquid firms to be more likely to repurchase at a premium (or less likely to repurchase at a discount). Thus, in Table 12, we repeat the analysis of Table 10, including the bid-ask spread as an explanatory variable.

We find that firms more likely in need of price support (less liquid firms with a higher bid-ask spread) repurchase at a *lower* relative repurchase price (though only significant using the six month comparison period), inconsistent with the price support hypothesis. Further, we find that our previous results hold, after controlling for this measure of liquidity. The evidence

[14] In untabulated results, we also divide the sample based on the highest and lowest quartile of the bid-ask spread and test for difference in the long-run performance of these groups. The alpha on the difference in these two subgroup portfolios is insignificantly different from zero.

presented in Table 12 suggests that undervaluation, not price support, drives our primary results. The implications of these results differ from those in Bonaime and Ryngaert (2013), who show repurchases coincide with insider trades when firms are illiquid, which they interpret as evidence that price support drives repurchase behavior.

To further examine the potential for price support, we build on the assumption that firms repurchasing at a premium are more likely to be conducting price support than to be taking advantage of undervaluation. In our sample of 38,900 monthly repurchases, 16,210 (or 42%) are repurchased at a premium using the three-month after comparison period. The median premium paid by those repurchasing at a premium is slightly smaller but comparable in magnitude to the median discount paid by those repurchasing at a discount. In Panel F of Table 11, we divide the sample into those firms that repurchase at a premium or a discount (based on the three-month after comparison period). Of course, the alpha in the three-month horizon is positive (negative) for those that repurchased at a discount (premium). Going forward, the portfolio of repurchases done at a discount continues to exhibit significantly negative alphas through the two-year horizon. Over all horizons, the portfolio of repurchases done at a premium significantly underperforms the portfolio of repurchases done at a discount. This evidence that a portfolio of repurchases done at a premium earns significantly negative long-run returns (and significantly underperforms those repurchased at a discount) reflects that these firms repurchase at relatively high prices, even up to two years out. If we assume that all premium repurchases are done for price support, this result provides evidence consistent with price support for some repurchasers.

6. Conclusion

By utilizing a new dataset of monthly prices and shares repurchased for a complete sample of U.S. firms that repurchased stock on the open market between 2004 and 2011, this

paper examines the ability of firms to time the market using repurchases. We compare the actual price paid in the repurchase to the average market price of the stock over several windows. We show that many firms time the market with repurchases. The average firm repurchases at a price that is two percent less than a naïve investor, and infrequent repurchasers repurchase at a price that is six to eight percent less than the average price in the market. These superior returns are also higher when insiders buy stock on their own account in the same month, indicating that these repurchases are driven by market timing.

To determine if the mispricing is evident at the announcement or revealed through information in the market prior to the repurchase, we examine how the price paid in the repurchase relates to announcement returns, the stated motivation for the repurchase, information asymmetry, and forecasts by analysts. We find little or no significant relation between the announcement return or stated motivation and the relative repurchase price. However, we find that firms pay a lower price after a stock price run down. This evidence is consistent with the firm responding to the market's overreaction to negative information about the firm through repurchases. We also find that firms pay a lower price after an aggregate market downturn, suggesting managers time both the aggregate market as well as the market for their own stock.

Do these lower prices paid in a repurchase result in long-run abnormal performance? Controlling for the Fama-French factors, we show that, on average, repurchasing firms have a positive and significant alpha of 0.3% per month over three to 36 months post-repurchase. Further, infrequent repurchasers earn a significantly greater return than frequent repurchasers, with an alpha on the difference between the groups of 0.6% per month over three months and 0.3% per month over 36 months. Thus, using actual repurchase price data, this paper shows that many firms are able to time the market in a stock repurchase.

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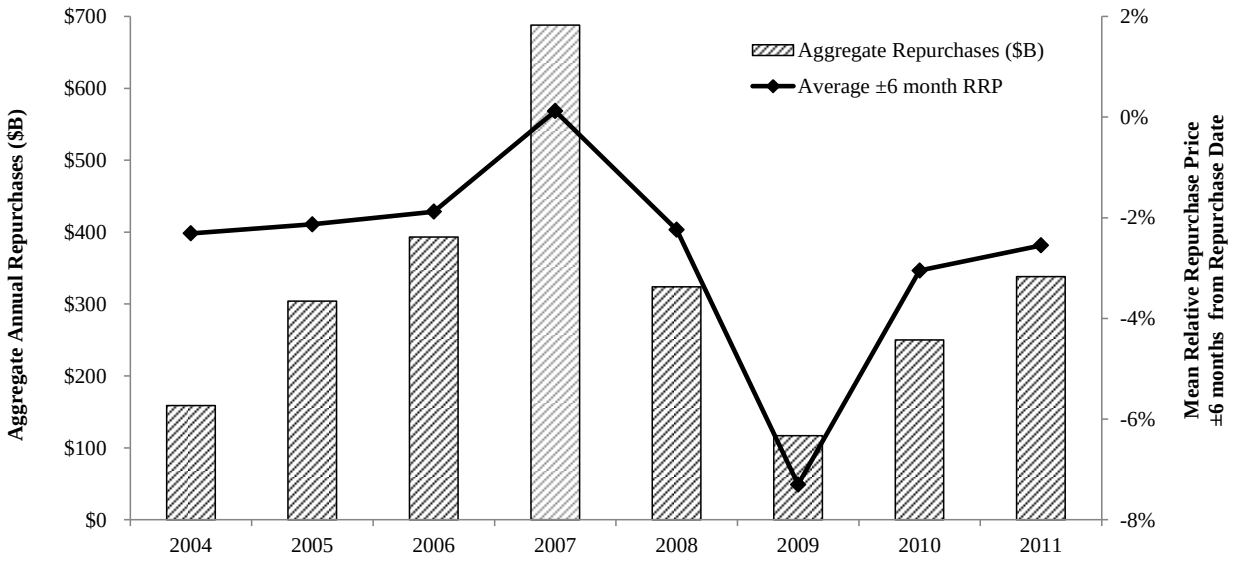
Appendix I: Variable definitions

Variable	Definition
Data from 10-Ks on EDGAR:	
Frequent repurchaser	Indicator equal to one if the firm repurchases nine or more months in a given year.
Infrequent repurchaser	Indicator equal to one if the firm repurchases four or fewer months in a given year.
Annual repurch/MV	Sum annually of the monthly amounts spent on repurchases divided by the prior period's market value of equity.
Repurch size/MV	Average price paid for the shares repurchased times the number of shares repurchased (as given the 10-K) divided by the market value of equity from the previous quarter (from Compustat).
Data from Compustat, measured at fiscal year-end prior to repurchase:	
Total assets	Given in millions, adjusted for inflation, given in 2011 dollars.
Market-to-book	Market-to-book ratio, measured as market value of equity plus the long term debt and the current portion of long term debt divided by total assets.
Return on assets	Measured as income before extraordinary items for the four quarters prior to the repurchase divided by total assets.
Leverage	Long-term debt and the current portion of long term debt divided by total assets.
Cash-to-assets	Measured as cash and equivalents divided by total assets.
Dividend payout	Measured as cash dividends divided by total assets.
Data from CRSP:	
Announcement return	Three-day abnormal return, measured net of the value-weighted CRSP market, surrounding the announcement of the stock repurchase program.
Prior six month market return	The CRSP value-weighted index return for the six month period prior to the actual repurchase.
Prior six month firm abnormal return	Compounded daily excess returns for the repurchasing firm (over the CRSP value-weighted index), measured over the six month period prior to repurchase month.
Bid-ask spread	Average bid/ask spread measured over prior six months.
Data from IBES:	
Number of analysts	Natural log of the number of analysts following the stock from IBES prior to the repurchasing month.
Percent of analyst downgrades	Number of analyst downgrades/total number of analyst recommendations for repurchasing firm. Includes all analyst recommendation events covered by I/B/E/S in the six months prior to the repurchase month.
Change in six month average EPS forecast	Change in average EPS forecasts of all analysts for the repurchasing firm, measured from six months prior to the repurchase through the repurchase month.
EPS forecast dispersion	Standard deviation of EPS forecasts divided by the average forecast using the forecast closest but prior to the repurchase month.
Data from the Insider Filing Data Feed, from Thomson Reuters:	
Net insider buying	Net insider purchases minus insider sales in the month of the repurchase, divided by the shares outstanding in the quarter prior to the repurchase.
Data from Factiva:	
Stated motivation of mispricing	Indicator equal to one if repurchase program announcement includes mention of "undervaluation" or "best use of money", as in Peyer and Vermaelen (2009).

Figure 1: Aggregate Annual Dollar Value of Repurchases versus the Relative Repurchase Price (RRP) and three year buy-and-hold abnormal returns

The figures in Panels A and B provide bar graphs of the aggregate annual repurchases ($B) from 2004-2011. For Panel A, the solid line presents the mean relative repurchase price for each year, 2004-2011, where the RRP (relative repurchase price) is measured as the percentage difference between the average repurchase price paid by the firm during the repurchase month (as reported in the 10-K) and the average closing stock prices as reported on CRSP for the six months surrounding the repurchase month. For Panel B, the solid line presents average three-year buy-and-hold abnormal returns, by annual cohort, relative to 25 size and B/M matched portfolios obtained from Kenneth French's website.

Panel A: Aggregate repurchases (left scale) versus average ±6 month RRP (right scale)



Panel B: Aggregate repurchases (left scale) versus average three-year BHARs (right scale)

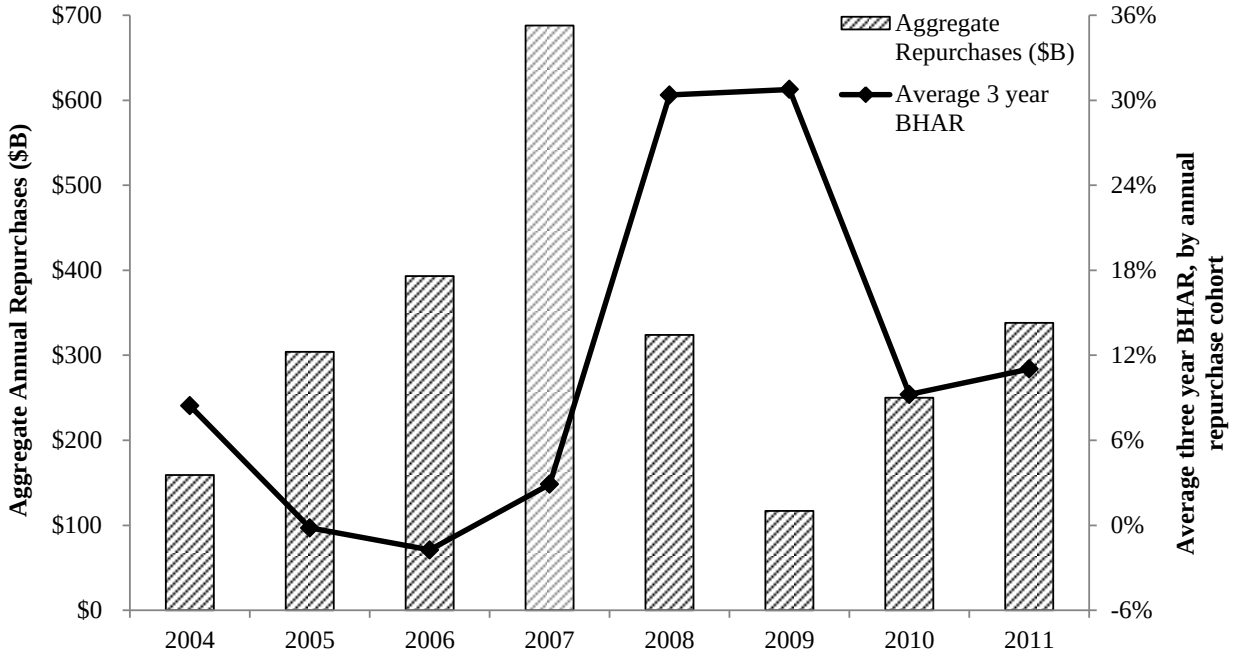


Table 1: Summary statistics for firms conducting repurchases, summarized by firm-year

The sample represents a panel of 7,496 repurchasing firm-years, in which firms are included in the sample if they conducted at least one repurchase in any given year from 2004-2011. In each calendar year, firms are categorized based upon the frequency of repurchases. Infrequent repurchasers are firms that repurchase one to four times in a given year, moderate repurchasers are firms that repurchase five to eight times in a given year, and frequent repurchasers are firms that repurchase at least nine times in a given year.

Year	Aggregate repurchases ($B)	# firms repurchasing	Repurchasing frequency (as % repurchasers)		
			Infrequent	Moderate	Frequent
2004	$ 159	812	50.7%	31.4%	17.9%
2005	$ 304	974	46.5%	30.8%	22.7%
2006	$ 393	1,021	45.4%	33.6%	21.0%
2007	$ 688	1,046	49.4%	29.5%	21.0%
2008	$ 324	1,216	53.7%	30.4%	15.9%
2009	$ 117	675	59.1%	24.9%	16.0%
2010	$ 250	783	52.1%	29.0%	18.9%
2011	$ 338	969	47.4%	28.7%	23.9%
Repurchasing firm-years		7,496	50.2%	30.0%	19.8%
% of aggregate $ value of repurchases			19.2%	22.5%	58.3%

Table 2: Summary statistics

The sample represents a panel of 7,496 repurchasing firm-years, in which a firm-year observation consists of a firm conducting at least one repurchase during a given year from 2004-2011. The table provides means (medians) of characteristics of these repurchasing firm-years. In Panel A, firms are categorized based on repurchase frequency: infrequent repurchasers are firms that repurchase one to four times during the year, moderate repurchasers are firms that repurchase five to eight times a year, and frequent repurchasers are firms that repurchase at least nine times per year. In Panel B, firms are categorized by whether the majority (at least 75%) of their monthly repurchases in a given year were bought at a discount to the firm's average stock price on CRSP for the same month. For both panels, accounting variables are summarized at the firm-year, measured at the fiscal year end before the repurchase month, except for RepurchSize/MV, which is summarized at the firm-month observation (frequency in which repurchase data are available). See Appendix I for variable definitions. ***,**,* indicate significant differences between the groups presented at the 1%, 5% and 10% levels, respectively, using t-tests for means and the Wilcoxon non-parametric test for medians.

Panel A: Summary statistics by repurchase frequency

		Repurchase frequency			Difference: Frequent – Infrequent
Firm characteristic	**Full sample**	**Infrequent**	**Moderate**	**Frequent**	
Total assets (millions)	6.993 (1.044)	3.380 (0.684)	5.321 (1.249)	18.718 (2.999)	15.339*** (2.315***)
Market-to-book	1.823 (1.455)	1.747 (1.378)	1.876 (1.508)	1.936 (1.626)	0.189*** (0.248***)
Return on assets	6.05% (6.36%)	4.76% (5.50%)	7.00% (6.82%)	7.90% (7.61%)	0.031*** (0.021***)
Leverage	17.18% (13.63%)	17.45% (13.24%)	16.34% (12.40%)	17.77% (16.17%)	0.003 (0.029***)
Cash-to-assets	19.50% (12.53%)	20.53% (13.44%)	19.65% (13.10%)	16.65% (10.56%)	−0.039*** (−0.029***)
Dividend payout	3.56% (0.00%)	3.01% (0.00%)	3.75% (0.00%)	4.66% (2.24%)	0.017*** (0.022***)
Bid-ask spread	0.44% (0.15%)	0.55% (0.18%)	0.36% (0.13%)	0.28% (0.10%)	−0.003*** (−0.001***)
Volatility	0.94% (0.76%)	0.99% (0.78%)	0.94% (0.77%)	0.83% (0.69%)	−0.002*** (−0.001***)
Repurch size/MV	1.12% (0.37%)	2.49% (0.44%)	0.87% (0.42%)	0.56% (0.32%)	−0.019* (−0.001***)
Annual repurch/MV	5.69% (2.38%)	5.73% (1.19%)	5.44% (3.64%)	5.98% (4.57%)	0.003 (0.034***)
Observations	7,496	3,765	2,250	1,481	

Table 2: Summary statistics (continued)

Panel B: Summary statistics by repurchase discount or premium

Firm characteristic	Full sample	≥75% repurchases bought at discount?		Difference: No – Yes
		No	Yes	
Total assets (millions)	6.993 (1.044)	8.242 (1.198)	5.346 (0.897)	2.896*** (0.301***)
Market-to-book ratio	1.823 (1.455)	1.839 (1.468)	1.802 (1.435)	0.038 (0.034*)
Return on assets	6.05% (6.36%)	6.34% (6.47%)	5.67% (6.21%)	0.67%** (0.27%**)
Leverage	17.18% (13.63%)	17.23% (13.98%)	17.11% (13.03%)	0.11% (0.95%)
Cash-to-assets	19.50% (12.53%)	19.21% (12.23%)	19.87% (13.09%)	−0.66% (−0.87%*)
Dividend payout	3.56% (0.00%)	3.94% (0.00%)	3.05% (0.00%)	0.89%* (0.00%)
Bid-ask spread	0.44% (0.15%)	0.40% (0.14%)	0.49% (0.16%)	−0.09%*** (−0.03%***)
Stock return volatility	0.94% (0.76%)	2.43% (2.15%)	2.73% (2.37%)	−0.30%*** (−0.22%***)
Repurch size/MV	1.12% (0.37%)	1.30% (0.39%)	0.74% (0.35%)	0.56% (0.04%***)
Annual repurch/MV	5.69% (2.38%)	7.71% (3.04%)	3.03% (1.64%)	4.68% (1.41%***)
Observations	7,496	4,262	3,234	

Table 3: Mean (median) relative repurchase price by year

The sample consists of 38,900 monthly repurchases conducted by 2,237 firms from 2004-2011. The table presents a measure of the percentage difference between the average (median) repurchase price paid by a firm during the repurchase month (as reported in the 10-K) and the average closing stock prices (as reported on CRSP) during the repurchase month, as well as windows around the repurchase: the repurchase month plus or minus one, three, and six months and the repurchase month plus one, three, and six months. This percentage is termed the RRP (relative repurchase price) and is measured as:

RRP = (Average repurchase price paid)/(Average closing price from CRSP) – 1.

***,**,* indicate significant differences between the groups presented at the 1%, 5% and 10% levels, respectively, using t-tests for means and the Wilcoxon non-parametric test for medians.

Year	No. monthly repurchases	Repurchase month	Repurchase month: ±1 month	Repurchase month: ±3 months	Repurchase month: ±6 months	Repurchase month: +1 month	Repurchase month: +3 months	Repurchase month: +6 months
2004	4,082	−0.87%*** (−0.38%***)	−1.26%*** (−0.86%***)	−1.84%*** (−1.36%***)	−2.31%*** (−1.81%***)	−1.27%*** (−1.13%***)	−2.11%*** (−2.11%***)	−3.08%*** (−3.39%***)
2005	5,364	−0.53%*** (−0.21%***)	−0.93%*** (−0.56%***)	−1.64%*** (−1.23%***)	−2.13%*** (−1.77%***)	−0.88%*** (−0.70%***)	−1.70%*** (−1.56%***)	−2.91%*** (−2.86%***)
2006	5,585	−0.62%*** (−0.30%***)	−0.86%*** (−0.66%***)	−1.29%*** (−1.07%***)	−1.88%*** (−1.87%***)	−0.80%*** (−0.78%***)	−1.44%*** (−1.87%***)	−2.57%*** (−3.50%***)
2007	5,534	−0.67%*** (−0.31%***)	−0.89%*** (−0.64%***)	−0.76%*** (−0.42%***)	0.12% (0.30%*)	−0.18%*** (−0.41%***)	1.14%*** (0.44%***)	3.29%*** (1.80%***)
2008	5,898	−0.67%*** (−0.43%***)	−1.45%*** (−0.98%***)	−2.56%*** (−2.00%***)	−2.24%*** (−1.55%***)	1.48%*** (0.23%***)	6.32%*** (2.67%***)	13.58%*** (8.40%***)
2009	3,084	−1.25%*** (−0.64%***)	−2.00%*** (−1.19%***)	−3.65%*** (−2.34%***)	−7.30%*** (−4.67%***)	−2.68%*** (−2.08%***)	−6.25%*** (−5.23%***)	−10.95%*** (−9.46%***)
2010	3,965	−0.85%*** (−0.44%***)	−1.33%*** (−1.10%***)	−2.11%*** (−1.96%***)	−3.05%*** (−2.71%***)	−1.76%*** (−1.72%***)	−3.68%*** (−3.92%***)	−6.23%*** (−6.63%***)
2011	5,388	−0.87%*** (−0.41%***)	−1.40%*** (−1.20%***)	−2.17%*** (−1.70%***)	−2.55%*** (−2.22%***)	−0.86%*** (−1.06%***)	−1.17%*** (−1.75%***)	−1.44%*** (−2.87%***)
All	38,900	−0.76%*** (−0.36%***)	−1.22%*** (−0.86%***)	−1.91%*** (−1.37%***)	−2.37%*** (−1.77%***)	−0.68%*** (−0.88%***)	−0.58%*** (−1.50%***)	−0.27%*** (−2.34%***)

Table 4: Mean (median) relative repurchase price by repurchase frequency

The sample consists of 38,900 monthly repurchases conducted by 2,237 firms from 2004-2011. The table presents a measure of the percentage difference between the average (median) repurchase price paid by a firm during the repurchase month (as reported in the 10-K) and the average closing stock prices (as reported on CRSP) during the repurchase month, as well as windows around the repurchase: the repurchase month plus or minus one, three, and six months and the repurchase month plus one, three, and six months. This percentage is termed the RRP (relative repurchase price), measured as:

RRP = (Average repurchase price paid)/(Average closing price from CRSP) – 1.

Means and medians are reported by repurchasing frequency. "Difference of infrequent – frequent" measures the significance of the difference in relative repurchase price for monthly repurchasers minus that for infrequent repurchases (those repurchasing fewer than five times a year). ***,**,* indicate significant differences between the groups presented at the 1%, 5% and 10% levels, respectively, using t-tests for means and the Wilcoxon non-parametric test for medians.

Repurchase frequency	Repurchase month	Repurchase month:			Repurchase month:		
		±1 month	±3 months	±6 months	+1 month	+3 months	+6 months
Infrequent repurchasers:							
Once per year	−1.73%***	−3.54%***	−5.92%***	−8.19%***	−2.15%***	−2.84%***	−3.24%***
	(−1.00%***)	(−2.76%***)	(−5.11%***)	(−7.25%***)	(−2.24%***)	(−4.01%***)	(−5.91%***)
2−4 times a year	−1.27%***	−2.35%***	−4.27%***	−6.13%***	−1.15%***	−1.27%***	−1.39%***
	(−0.80%***)	(−1.92%***)	(−3.60%***)	(−5.34%***)	(−1.39%***)	(−2.44%***)	(−3.96%***)
Moderate repurchasers:							
5−8 times a year	−0.81%***	−1.22%***	−1.73%***	−1.96%***	−0.66%***	−0.34%***	0.33%**
	(−0.50%***)	(−0.99%***)	(−1.43%***)	(−1.87%***)	(−0.92%***)	(−1.50%***)	(−2.16%***)
Frequent repurchasers:							
9−11 times a year	−0.50%***	−0.65%***	−0.83%***	−0.74%***	−0.47%***	−0.35%***	−0.07%
	(−0.28%***)	(−0.53%***)	(−0.67%***)	(−0.67%***)	(−0.70%***)	(−1.18%***)	(−1.85%***)
Monthly	−0.17%***	−0.22%***	−0.24%***	−0.02%	−0.20%***	−0.18%*	−0.03%
	(−0.09%***)	(−0.21%***)	(−0.08%***)	(0.11%)	(−0.50%***)	(−0.96%***)	(−1.52%***)
Difference of infrequent – frequent:							
Means	−0.93%***	−1.99%***	−3.84%***	−5.87%***	−0.89%***	−1.15%***	−1.54%***
Medians	(−0.63%***)	(−1.60%***)	(−3.30%***)	(−5.14%***)	(−0.85%***)	(−1.50%***)	(−2.42%***)

Table 5: Regressions of relative repurchase price

The table reports regressions of the relative repurchase price on firm and repurchasing characteristics. The RRP (relative repurchase price) is measured as the percentage difference between the average repurchase price paid by the firm during a repurchase month (as reported in the 10-K) and the average closing stock prices as reported on CRSP, during various windows: repurchase month plus or minus one, three, and six months and the repurchase month plus one, three, and six months, where:

RRP = (Average repurchase price paid)/(Average closing price from CRSP) – 1.

Accounting variables are summarized at the firm-year, measured at the fiscal year end before the repurchase month. See Appendix I for variable definitions. The regressions include year and firm fixed effects and clustered standard errors at the firm level. P-values are in parentheses; ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Repurchase month:			**Repurchase month:**		
	±1 month	**±3 months**	**±6 months**	**+1 month**	**+3 months**	**+6 months**
Infrequent repurchaser	−0.006***	−0.014***	−0.022***	−0.004***	−0.010***	−0.020***
	(0.000)	(0.000)	(0.000)	(0.006)	(0.000)	(0.000)
Frequent repurchaser	0.003***	0.005***	0.006***	0.002*	0.002	0.001
	(0.000)	(0.000)	(0.001)	(0.089)	(0.478)	(0.759)
Ln(total assets)	−0.004*	−0.003	0.011**	0.013***	0.046***	0.081***
	(0.068)	(0.445)	(0.025)	(0.000)	(0.000)	(0.000)
Market-to-book	−0.004***	0.001	0.018***	0.005***	0.019***	0.035***
	(0.000)	(0.331)	(0.000)	(0.000)	(0.000)	(0.000)
Return on assets	−0.010	−0.025**	−0.040**	−0.021**	−0.036*	−0.030
	(0.231)	(0.047)	(0.034)	(0.035)	(0.075)	(0.344)
Leverage	0.004	0.003	−0.002	0.013*	0.010	0.012
	(0.505)	(0.801)	(0.872)	(0.090)	(0.540)	(0.655)
Cash-to-assets	−0.000	−0.004	0.009	−0.019***	−0.043***	−0.054***
	(0.974)	(0.580)	(0.433)	(0.003)	(0.001)	(0.008)
Return volatility	−0.182*	−0.880***	−1.660***	−0.292**	−0.610**	−1.214***
	(0.090)	(0.000)	(0.000)	(0.018)	(0.017)	(0.000)
Prior six month market return	0.019***	0.089***	0.244***	0.034***	0.091***	0.177***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	0.029*	0.013	−0.115***	−0.114***	−0.380***	−0.662***
	(0.097)	(0.623)	(0.001)	(0.000)	(0.000)	(0.000)
Adjusted R^2	0.140	0.177	0.274	0.130	0.228	0.353
Observations	37,283	37,283	37,283	37,283	37,283	37,283

Table 6: Mean (median) relative repurchase price by level of insider trading

The table reports mean (median) relative repurchase prices for 17,622 repurchases by firms during months in which insiders also trade on their own account, from 2004-2011. Insider trades are measured as net insider purchases minus insider sales for each month, scaled by the shares outstanding at the end of the prior period. The RRP (relative repurchase price) is measured as the percentage difference between the average repurchase price paid by the firm during the repurchase month (as reported in the 10-K) and the average closing stock prices as reported on CRSP, during various windows: the repurchase month plus or minus one, three, and six months and the repurchase month plus one, three, and six months, where:

RRP = (Average repurchase price paid)/(Average closing price from CRSP) – 1.

Firms are broken into quartiles, based upon the amount of relative insider buying (insider buys minus insider sells). ***,**,* indicate significant differences between the groups presented at the 1%, 5% and 10% levels, respectively, using t-tests for means and the Wilcoxon non-parametric test for medians.

Insider trading shares	**Repurchase Month**	**Repurchase month:**			**Repurchase month:**		
		±1 month	**±3 months**	**±6 months**	**+1 month**	**+3 months**	**+6 months**
Quartile 1 *(less insider buying)*	−0.94%*** (−0.50%***)	−0.63%*** (−0.24%***)	−0.03% (0.32%)	0.90%*** (0.92%***)	−1.26%*** (−1.10%***)	−1.26%*** (−1.65%***)	−0.93%*** (−2.40%***)
Quartile 2	−0.73%*** (−0.39%***)	−0.57%*** (−0.30%***)	−0.17%* (0.02%)	0.44%*** (0.45%***)	−0.88%*** (−0.90%***)	−0.84%*** (−1.53%***)	−0.64%*** (−2.16%***)
Quartile 3	−0.64%*** (−0.31%***)	−0.71%*** (−0.55%***)	−0.74%*** (−0.44%***)	−0.47%*** (−0.26%***)	−0.68%*** (−0.80%***)	−0.67%*** (−1.39%***)	−0.31% (−2.12%***)
Quartile 4 *(more insider buying)*	−0.89%*** (−0.37%***)	−2.31%*** (−1.38%***)	−4.09%*** (−2.71%***)	−5.50%*** (−3.87%***)	−0.81%*** (−0.96%***)	−0.48%*** (−1.50%***)	−0.01% (−2.33%***)
Difference of Q4–Q1:							
Means	0.06%	−1.68%***	−4.06%***	−6.40%***	0.45%***	0.78%***	0.92%***
Medians	(0.13%)	(−1.14%***)	(−3.03%***)	(−4.80%***)	(0.13%***)	(0.15%)	(0.07%)

Table 7: Relative price regressions, including insider trading

The table reports regressions of the relative repurchase price on firm and repurchasing characteristics, including net insider buying (insider purchases minus insider sales) during the repurchasing month, scaled by shares outstanding. The RRP (relative repurchase price) is measured as the percentage difference between the average repurchase price paid by the firm during a repurchase month (as reported in the 10-K) and the average closing stock prices as reported on CRSP, during various windows surrounding the repurchase month (plus or minus one, three, and six months) and the repurchase plus one, three, and six months), where:

RRP = (Average repurchase price paid)/(Average closing price from CRSP) – 1.

Accounting variables are summarized at the firm-year, measured at the fiscal year end before the repurchase month. See Appendix I for variable definitions. All regressions include year and firm fixed effects and cluster standard errors at the firm level. P-values are in parentheses; ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Repurchase Month:			**Repurchase Month:**		
	±1 month	**±3 months**	**±6 months**	**+1 month**	**+3 months**	**+6 months**
Infrequent repurchaser	−0.007***	−0.015***	−0.023***	−0.023***	−0.013***	−0.023***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Frequent repurchaser	0.003***	0.005***	0.006**	0.003	0.002	0.003
	(0.005)	(0.008)	(0.035)	(0.470)	(0.435)	(0.470)
Net insider buying	−0.007***	−0.015***	−0.023***	−0.008***	−0.003***	−0.008***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Ln(total assets)	−0.004	−0.000	0.019***	0.088***	0.048***	0.088***
	(0.170)	(0.955)	(0.003)	(0.000)	(0.000)	(0.000)
Market-to-book	−0.004***	0.001	0.016***	0.034***	0.018***	0.034***
	(0.000)	(0.469)	(0.000)	(0.000)	(0.000)	(0.000)
Return on assets	−0.003	−0.021	−0.038	−0.002	−0.014	−0.002
	(0.801)	(0.310)	(0.209)	(0.950)	(0.563)	(0.950)
Leverage	0.003	0.004	0.002	0.009	0.006	0.009
	(0.711)	(0.790)	(0.909)	(0.802)	(0.782)	(0.802)
Cash-to-assets	0.006	−0.003	0.009	−0.037	−0.024	−0.037
	(0.389)	(0.743)	(0.553)	(0.120)	(0.104)	(0.120)
Return volatility	−0.295*	−0.911***	−1.561***	−1.387***	−0.777***	−1.387***
	(0.061)	(0.001)	(0.000)	(0.000)	(0.002)	(0.000)
Prior six month market return	0.019***	0.073***	0.208***	0.153***	0.087***	0.153***
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	0.052**	0.038	−0.120**	−0.726***	−0.398***	−0.726***
	(0.042)	(0.308)	(0.018)	(0.000)	(0.000)	(0.000)
Adjusted R^2	0.222	0.250	0.317	0.352	0.236	0.352
Observations	16,866	16,866	16,866	16,866	16,866	16,866

Table 8: Relative repurchase prices by three-day announcement CAR quartile

The table examines announcement returns for 2,921 repurchase program announcements made from 1999-2011 (announcing subsequent repurchases in our sample, which covers the period 2004-2011). Announcements made in conjunction with an earnings announcement are not included in the sample.

The second column presents the mean (median) three-day CARs for these 2,921 repurchase program announcements, broken into quartiles based upon the size of the announcement return, where Quartile 1 includes announcements with the lowest CARs and Quartile 4 represents announcements with the highest CARs. Columns 3-9 present the mean (median) relative price paid, by CAR level quartiles, for 20,973 repurchases conducted during 2004-2011, following the 2,921 repurchase program announcements. The RRP (relative repurchase price) is measured as the percentage difference between the average repurchase price paid by the firm during a repurchase month (as reported in the 10-K) and the average closing stock prices as reported on CRSP, during various windows surrounding the repurchase month (plus or minus one, three, and six months) and the repurchase plus one, three, and six months, where:

Relative repurchase price = (Average repurchase price paid)/(Average closing price from CRSP) – 1.

***, **, * denote that the average (median) relative price is significantly different from zero at the 1%, 5%, and 10% levels, respectively, using t-tests for means and the Wilcoxon non-parametric test for medians.

CAR quartile	Announce-ment CARs	Relative repurchase price for:						
		Repurchase month	Repurchase month:					
			±1 month	±3 months	±6 months	+6 months	+3 months	+6 months
Quartile 1 (lowest)	−5.28%*** (−2.94%***)	−0.85%*** (−0.41%***)	−1.44%*** (−1.03%***)	−2.41%*** (−1.88%***)	−3.29%*** (−2.48%***)	−0.74%*** (−0.90%***)	−0.69%*** (−1.53%***)	−0.54%** (−2.68%***)
Quartile 2	0.34%*** (0.38%***)	−0.64%*** (−0.30%***)	−0.96%*** (−0.69%***)	−1.36%*** (−0.93%***)	−1.52%*** (−1.11%***)	−0.52%*** (−0.76%***)	−0.31%** (−1.30%***)	0.01% (−2.03%***)
Quartile 3	2.85%*** (2.80%***)	−0.86%*** (−0.42%***)	−1.27%*** (−0.90%***)	−1.90%*** (−1.37%***)	−2.24%*** (−1.70%***)	−0.86%*** (−1.01%***)	−0.89%*** (−1.74%***)	−0.62%*** (−2.57%***)
Quartile 4 (highest)	9.68%*** (7.38%***)	−0.79%*** (−0.15%***)	−1.50%*** (−1.10%***)	−2.51%*** (−2.12%***)	−3.25%*** (−2.87%***)	−0.68*** (−1.04%***)	−0.38%* (−1.56%***)	0.22% (−2.24%***)
Difference of Q4 – Q1:								
Means	14.96%***	0.06%	−0.06%	−0.10%	0.04%	0.05%	0.31%	0.75%**
Medians	(10.32%***)	(0.01%)	(−0.07%)	(−0.24%)	(−0.39%)	(−0.15%)	(−0.03%)	(0.44%)

Table 9: CARs and RRP by stated repurchase motivation

The table examines the stated motivation for repurchases for 2,921 repurchase program announcements made from 1999-2011 (announcing subsequent repurchases in our sample, which covers the period 2004-2011). Following Peyer and Vermaelen (2009), repurchase announcements are categorized into several categories of "motivation" for the share repurchase, and we select firms that mention "undervaluation" and "best use of money" as those with a stated motivation of mispricing. Panel A presents the mean (median) three-day CARs for these repurchase program announcements, categorized by whether the firm made a repurchase announcement that suggests the stock may be mispriced. Panel B presents the mean (median) relative price paid for repurchases, differentiated by whether the firm announces that the repurchase motivation is driven by mispricing. The RRP (relative repurchase price) is measured as the percentage difference between the average repurchase price paid by the firm during a repurchase month (as reported in the 10-K) and the average closing stock prices as reported on CRSP, during various windows surrounding the repurchase month (plus or minus one, three and six months) and for the repurchase month plus one, three, and six months, where:

Relative repurchase price = (Average repurchase price paid)/(Average closing price from CRSP) – 1.

***, **, * denote that the average (median) relative price is significantly different from zero at the 1%, 5%, and 10% levels (using t-test for means and Wilcoxon test for medians).

Panel A: Mean and median three-day CARs by stated repurchase motivation

Stated repurchase motivation	Mean CAR	# of Announcements
Stated motivation of mispricing	2.09%***	1,397
	(1.65%)***	
No stated motivation of mispricing	1.67%***	1,524
	(1.22%)***	
Difference	0.42%	2,921
	(0.43%)**	

Panel B: Mean (median) relative repurchase price by stated repurchase motivation

Repurchase Motivation	Repurchase month	Repurchase month:			Repurchase month:		
		±1 month	±3 months	±6 months	+1 months	+3 months	+6 months
Stated motivation of mispricing	−0.81%***	−1.33%***	−2.09%***	−2.62%***	−0.74%***	−0.59%***	−0.21%
	(−0.40%***)	(−0.97%***)	(−1.49%***)	(−2.04%***)	(−0.95%***)	(−1.56%***)	(−2.44%***)
No stated motivation of mispricing	−0.73%***	−1.17%***	−1.82%***	−2.26%***	−0.66%***	−0.57%***	−0.29%***
	(−0.34%***)	(−0.83%***)	(−1.30%***)	(−1.65%***)	(−0.85%***)	(−1.47%***)	(−2.29%***)
Difference of stated motivation – no stated motivation							
Means	−0.08%	−0.16%***	−0.26%***	−0.37%***	−0.08%	−0.03%	0.08%
Medians	(−0.06%*)	(−0.14%***)	(−0.19%***)	(−0.39%***)	(−0.11%*)	(−0.09%)	(−0.16%)

Table 10: Relative price regressions, including insider trading, measures of information asymmetry and market overreaction

The table reports regressions of the relative repurchase price on firm and repurchasing characteristics, as well as several potential measures indicating undervaluation. Panel A provides data for the full sample, while Panel B omits the first repurchase following the announcement. The RRP (relative repurchase price) is measured as the percentage difference between the average repurchase price paid by the firm during a repurchase month (as reported in the 10-K) and the average closing stock prices as reported on CRSP, during various windows: repurchase month ±1, 3, 6 months and repurchase month plus one, three, and six months, where:

RRP = (Average repurchase price paid)/(Average closing price from CRSP) – 1.

Accounting variables are summarized at the firm-year, measured at the fiscal year end before the repurchase month. Data on analysts are measured at the quarter prior to repurchase. Prior six month return is measured in the six months prior to repurchase month. See Appendix I for variable definitions. All regressions include year and firm fixed effects and cluster standard errors at the firm level. P-values are in parentheses; ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table 10 (continued)

Panel A. Full sample

	Repurchase month		
	+1 month	**+3 months**	**+6 months**
Infrequent repurchaser	−0.006***	−0.014***	−0.023***
	(0.004)	(0.000)	(0.000)
Frequent repurchase	0.001	−0.000	0.000
	(0.642)	(0.967)	(0.978)
Net insider buying	0.001	−0.001	−0.005***
	(0.260)	(0.171)	(0.000)
Ln(total assets)	0.011***	0.047***	0.085***
	(0.005)	(0.000)	(0.000)
Market-to-book	0.004***	0.016***	0.029***
	(0.000)	(0.000)	(0.000)
Return on assets	−0.013	−0.005	0.015
	(0.305)	(0.842)	(0.700)
Leverage	0.010	0.009	0.006
	(0.365)	(0.704)	(0.880)
Cash-to-assets	−0.004	−0.023	−0.037
	(0.623)	(0.159)	(0.163)
Return volatility	−0.554***	−0.788***	−1.532***
	(0.006)	(0.008)	(0.000)
Prior six month market return	0.030***	0.084***	0.140***
	(0.000)	(0.000)	(0.000)
Ln(Number of analysts)	−0.004*	−0.008	−0.006
	(0.088)	(0.112)	(0.412)
Percent of analyst downgrades	0.016	0.011	0.014
	(0.165)	(0.536)	(0.530)
EPS forecast dispersion	−0.001	−0.003	−0.003
	(0.531)	(0.195)	(0.413)
Change in six month average EPS forecast	0.003	0.010*	0.016*
	(0.236)	(0.085)	(0.086)
Stated motivation of mispricing	−0.001	−0.002	−0.002
	(0.434)	(0.612)	(0.729)
Prior six month firm abnormal return	0.006*	0.027***	0.046***
	(0.092)	(0.000)	(0.000)
Intercept	−0.095***	−0.386***	−0.702***
	(0.004)	(0.000)	(0.000)
Adjusted R^2	0.154	0.224	0.342
Observations	15,206	15,206	15,206

Table 10 (continued)

Panel B: Full sample, omitting first repurchase after announcement

	Repurchase month		
	+1 month	**+3 months**	**+6 months**
Infrequent repurchaser	−0.005**	−0.014***	−0.022***
	(0.012)	(0.000)	(0.000)
Frequent repurchase	0.001	0.000	0.001
	(0.594)	(0.874)	(0.846)
Net insider buying	0.000	−0.001	−0.005***
	(0.381)	(0.150)	(0.000)
Ln(total assets)	0.011**	0.046***	0.083***
	(0.010)	(0.000)	(0.000)
Market-to-book	0.004***	0.015***	0.028***
	(0.000)	(0.000)	(0.000)
Return on assets	−0.016	−0.006	0.016
	(0.220)	(0.814)	(0.687)
Leverage	0.009	0.010	0.012
	(0.437)	(0.688)	(0.738)
Cash-to-assets	−0.003	−0.020	−0.034
	(0.713)	(0.227)	(0.206)
Return volatility	−0.584***	−0.780**	−1.492***
	(0.007)	(0.012)	(0.001)
Prior six month market return	0.029***	0.083***	0.139***
	(0.000)	(0.000)	(0.000)
Ln(Number of analysts)	−0.003	−0.006	−0.005
	(0.179)	(0.190)	(0.549)
Percent of analyst downgrades	0.013	0.010	0.018
	(0.297)	(0.577)	(0.448)
EPS forecast dispersion	−0.001	−0.004*	−0.005
	(0.443)	(0.099)	(0.205)
Change in six month average EPS forecast	0.003	0.010*	0.018*
	(0.238)	(0.072)	(0.068)
Stated motivation of mispricing	−0.001	−0.001	0.001
	(0.523)	(0.863)	(0.899)
Prior six month firm abnormal return	0.005	0.027***	0.047***
	(0.164)	(0.000)	(0.000)
Intercept	−0.093***	−0.383***	−0.695***
	(0.007)	(0.000)	(0.000)
Adjusted R^2	0.157	0.226	0.346
Observations	14,432	14,432	14,432

Table 11: Fama French regressions

The table presents Fama-French regressions of market returns for various return windows following 38,900 repurchase months from 2004-2011. For each calendar month of the sample period, we construct a portfolio comprising all firms making a repurchase within the prior three, six, 12, 24, or 36 months. To do this, we add firms to the portfolio in the month that they repurchase stock and the stock is retained in the portfolio for three, six, 12, 24, or 36. Portfolios are rebalanced each month and an equal-weighted portfolio excess return is calculated. The resulting time series of monthly excess returns is regressed on the three Fama-French (1993) factors: the market return minus the risk-free rate (RMRF), returns on a portfolio of small firms minus returns on a portfolio of big firms (SMB), and returns on a high BM portfolio minus returns on a low BM portfolio (HML). The estimated intercept from the regression of portfolio returns is used as a measure of abnormal performance.

Panel A presents the results for the full sample, for various windows of N months. Panels B through F provide results for various subsamples of repurchasing firms. ***, **, and * indicate significance of coefficients at the 1%, 5%, and 10% level, respectively.

Panel A: Fama-French regressions for the full sample

	Intercept	RMRF	SMB	HML	Adj R^2
Three months	0.004***	0.994***	0.507***	−0.047	0.95
Six months	0.004***	0.996***	0.503***	−0.010	0.96
One year	0.003***	0.993***	0.523***	0.050	0.96
Two years	0.003***	1.000***	0.533***	0.090*	0.96
Three years	0.003***	1.013***	0.544***	0.111**	0.96

Panel B: Subsample analysis, by firm repurchasing frequency

	Intercept	RMRF	SMB	HML	Adj R^2
Three month returns:					
Infrequent: 1-4 times/year	0.008***	1.099***	0.706***	−0.058	0.92
Frequent: ≥9 times/year	0.002***	0.917***	0.355***	−0.015	0.97
Frequent − Infrequent	−0.006***	−0.182***	−0.350***	0.043	0.40
Six month returns:					
Infrequent: 1-4 times/year	0.007***	1.093***	0.664***	−0.026	0.93
Frequent: ≥9 times/year	0.002**	0.923***	0.373***	−0.000	0.96
Frequent − Infrequent	−0.005***	−0.169***	−0.291***	0.026	0.42
One year returns:					
Infrequent: 1-4 times/year	0.006***	1.068***	0.711***	0.046	0.94
Frequent: ≥9 times/year	0.002*	0.934***	0.382***	0.028	0.96
Frequent − Infrequent	−0.005***	−0.134***	−0.329***	−0.018	0.49
Two year returns:					
Infrequent: 1-4 times/year	0.005***	1.077***	0.717***	0.099	0.94
Frequent: ≥9 times/year	0.002**	0.944***	0.393***	0.060	0.96
Frequent − Infrequent	−0.003***	−0.133***	−0.324***	−0.040	0.49
Three year returns:					
Infrequent: 1-4 times/year	0.005***	1.078***	0.719***	0.111*	0.94
Frequent: ≥9 times/year	0.002**	0.958***	0.411***	0.083**	0.96
Frequent − Infrequent	−0.003***	−0.120***	−0.308***	−0.028	0.46

Table 11: Fama French regressions (continued)

Panel C: Subsample analysis, by amount of net insider purchases

	Intercept	RMRF	SMB	HML	Adj R^2
Three month returns:					
Low insider net buys	0.002	0.840***	0.656***	−0.070	0.91
High insider net buys	0.006***	1.087***	0.338***	−0.058	0.90
High−Low	0.004*	0.247***	−0.318***	0.012	0.15
Six month returns:					
Low insider net buys	0.003**	0.873***	0.636***	−0.065	0.94
High insider net buys	0.005***	1.063***	0.370***	0.027	0.91
High – Low	0.002	0.190***	−0.266***	0.092	0.18
One year returns:					
Low insider net buys	0.003**	0.907***	0.628***	−0.045	0.95
High insider net buys	0.005***	1.051***	0.384***	0.078	0.92
High − Low	0.002	0.144***	−0.244***	0.122**	0.21
Two year returns:					
Low insider net buys	0.003***	0.946***	0.625***	−0.019	0.96
High insider net buys	0.004**	1.044***	0.447***	0.131**	0.92
High – Low	0.001	0.097***	−0.178***	0.150***	0.16
Three year returns:					
Low insider net buys	0.003**	0.980***	0.642***	0.046	0.95
High insider net buys	0.004***	1.049***	0.442***	0.151**	0.93
High − Low	0.001	0.070**	−0.199***	0.105**	0.13

Panel D: Subsample analysis, by stated repurchase motivation

	Intercept	RMRF	SMB	HML	Adj R^2
Three month returns:					
Stated motivation of mispricing	0.004***	1.008***	0.508***	−0.031	0.93
No stated mispricing motivation	0.005***	0.987***	0.508***	−0.054	0.96
Stated mispricing – None	−0.001	0.021	0.000	0.023	−0.01
Six month returns:					
Stated motivation of mispricing	0.003**	1.008***	0.499***	0.023	0.94
No stated mispricing motivation	0.004***	0.990***	0.505***	−0.025	0.96
Stated mispricing – None	−0.001	0.018	−0.008	0.047	0.00
One year returns:					
Stated motivation of mispricing	0.003**	1.002***	0.501***	0.106*	0.94
No stated mispricing motivation	0.004***	0.990***	0.534***	0.024	0.96
Stated mispricing – None	−0.001	0.013	−0.032	0.082**	0.07
Two year returns:					
Stated motivation of mispricing	0.002*	1.019***	0.518***	0.152***	0.95
No stated mispricing motivation	0.003**	0.992***	0.541***	0.062	0.96
Stated mispricing – None	−0.001	0.028	−0.023	0.089***	0.09
Three year returns:					
Stated motivation of mispricing	0.002*	1.045***	0.540***	0.169***	0.94
No stated mispricing motivation	0.003***	0.998***	0.547***	0.086*	0.96
Motivation – No Motivation	−0.001*	0.046**	−0.008	0.083***	0.16

Table 11: Fama French regressions (continued)

Panel E: Subsample analysis, by prior six month return

	Intercept	RMRF	SMB	HML	Adj R^2
Three month returns:					
Prior six month return negative	0.005***	1.069***	0.540***	−0.041	0.88
Prior six month return positive	−0.026***	0.908***	0.441***	−0.063	0.92
Prior return negative – positive	0.002	0.142**	0.060	0.018	0.07
Six month returns:					
Prior six month return negative	0.004**	1.058***	0.505***	0.050	0.90
Prior six month return positive	0.004***	0.940***	0.501***	−0.061	0.97
Prior return negative – positive	0.001	0.118**	0.004	0.111	0.09
One year returns:					
Prior six month return negative	0.004**	1.022***	0.565***	0.149**	0.92
Prior six month return positive	0.003***	0.963***	0.473***	−0.051	0.98
Prior return negative – positive	0.0002	0.059	0.092	0.201***	0.21
Two year returns:					
Prior six month return negative	0.003**	1.014***	0.597***	0.178***	0.93
Prior six month return positive	0.003**	0.983***	0.454***	−0.018	0.97
Prior return negative – positive	−0.0004	0.031	0.142***	0.195***	0.29
Three year returns:					
Prior six month return negative	0.003*	1.027***	0.608***	0.185***	0.94
Prior six month return positive	0.003***	0.995***	0.469***	0.018	0.97
Prior return negative – positive	−0.0008	0.032	0.139***	0.167***	0.38

Panel F: Subsample analysis, by whether relative repurchase price (RRP) was done at a discount or premium to average CRSP price for three months after repurchase

	Intercept	RMRF	SMB	HML	Adj R^2
Three month returns:					
Repurchased at discount	0.026***	0.855***	0.451***	−0.052	0.91
Repurchased at premium	−0.026***	0.908***	0.441***	−0.063	0.92
Discount – Premium	0.052***	−0.052	0.010	0.011	−0.01
Six month returns:					
Repurchased at discount	0.014**	0.935***	0.494***	−0.655	0.95
Repurchased at premium	−0.011***	1.008***	0.519***	−0.030	0.93
Discount – Premium	0.025***	−0.073*	−0.025	−0.036	0.04
One year returns:					
Repurchased at discount	0.009***	0.954***	0.513***	0.015	0.95
Repurchased at premium	−0.005***	1.02***	0.533***	0.078	0.93
Discount – Premium	0.014***	−0.066*	−0.020	−0.063	0.07
Two year returns:					
Repurchased at discount	0.007***	0.971***	0.502***	0.036	0.95
Repurchased at premium	−0.003**	1.022***	0.574***	0.145**	0.94
Discount – Premium	0.010***	−0.051	−0.072	−0.110*	0.09
Three year returns:					
Repurchased at discount	0.006***	0.988***	0.510***	0.074	0.95
Repurchased at premium	−0.002	1.036***	0.589***	0.152**	0.94
Discount – Premium	0.008***	−0.048	−0.080	−0.077	0.06

Table 12: Relative price regressions, including liquidity measure

The table repeats the analysis presented in Table 10, but includes the bid-ask spread as a measure of stock liquidity.

	Repurchase month		
	+1 month	**+3 months**	**+6 months**
Infrequent repurchaser	−0.006***	−0.014***	−0.023***
	(0.004)	(0.000)	(0.000)
Frequent repurchase	0.001	−0.000	0.000
	(0.619)	(0.987)	(0.952)
Net insider buying	0.001	−0.001	−0.005***
	(0.268)	(0.163)	(0.000)
Ln(total assets)	0.011**	0.046***	0.083***
	(0.011)	(0.000)	(0.000)
Stock return volatility	−0.477***	−0.686***	−1.298***
	(0.003)	(0.008)	(0.001)
Ln(Number of analysts)	−0.004*	−0.008*	−0.007
	(0.077)	(0.099)	(0.371)
EPS forecast dispersion	−0.001	−0.003	−0.003
	(0.574)	(0.214)	(0.457)
Prior six month firm abnormal return	0.006*	0.028***	0.047***
	(0.088)	(0.000)	(0.000)
Fraction of analyst downgrades	0.015	0.009	0.011
	(0.188)	(0.587)	(0.627)
Change in six month average EPS forecast	0.003	0.010*	0.017*
	(0.220)	(0.081)	(0.081)
Stated motivation of mispricing	−0.001	−0.002	−0.002
	(0.442)	(0.618)	(0.737)
Market-to-book ratio	0.004***	0.016***	0.028***
	(0.000)	(0.000)	(0.000)
Return on assets	−0.017	−0.010	0.003
	(0.207)	(0.679)	(0.947)
Leverage	0.011	0.010	0.007
	(0.338)	(0.678)	(0.839)
Cash-to-assets	−0.004	−0.023	−0.036
	(0.630)	(0.160)	(0.165)
Prior six month market return	0.031***	0.084***	0.140***
	(0.000)	(0.000)	(0.000)
Bid-ask spread	−1.429	−1.903	−4.349*
	(0.462)	(0.382)	(0.066)
Intercept	−0.088**	−0.377***	−0.682***
	(0.011)	(0.000)	(0.000)
Adjusted R^2	0.154	0.224	0.343
Observations	15,206	15,206	15,206