When Repurchases Resemble Dividends: Frequent versus Infrequent Repurchasers

by

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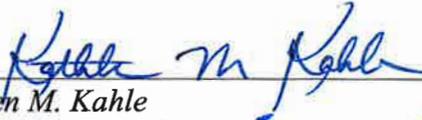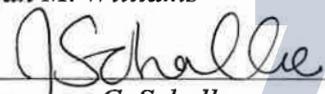
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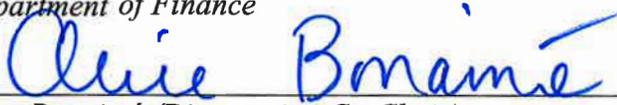
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DEDICATION

I dedicate this to my brother Ashish and my wife Madhavi, who have unequivocally supported and encouraged me through the highs and lows of life.

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ABSTRACT

I demonstrate that frequent repurchasers resemble dividend payers and their repurchases are sticky and inflexible, like dividends. In contrast, infrequent repurchasers follow a flexible buyback policy and quickly respond to earnings changes. Investors react more positively to infrequent repurchasers' repurchase announcements and actual repurchases, consistent with stronger signals of undervaluation and improvement in future prospects. Frequent repurchasers, however, repurchase to offset dilution caused by equity compensation. The shift in repurchase behavior from infrequent to frequent explains why traditional motives such as flexibility and signaling fail to describe the recent surge in repurchases.

1. Introduction

Repurchases have become a dominant form of payout, with more than half of US firms repurchasing in a year and the total amount of repurchases exceeding 650 billion dollars in 2016. Prior literature consistently identifies maintaining financial flexibility, signaling future prospects, and controlling dilution as three key reasons that firms prefer repurchases over dividends.[1] Skinner (2008) shows that firms have substituted dividends with repurchases because they are more flexible. Despite this, dividends have more than doubled during the last decade, and almost a quarter of all firms use both dividends and repurchases to distribute cash to shareholders in recent years.

Prior studies typically compare repurchases with dividends to determine repurchase motives. Since more than half of US firms have been repurchasing in recent years, it is also important to understand variation in repurchase motives. Once firms decide to repurchase, they may concentrate their repurchases in one quarter or spread them over multiple quarters. I exploit this variation in repurchase frequency to identify underlying repurchase motives. When firms repurchase frequently, investors upwardly revise expectations regarding the likelihood of future repurchases, thus rendering firms reluctant to cut existing repurchases in response to earnings shocks; these repurchases then become sticky like dividends. In contrast, when firms repurchase infrequently, their repurchases are unexpected and will convey a stronger positive signal.

To test this hypothesis, in each fiscal year, I classify firms that repurchase in three or four quarters as "frequent" repurchasers, in two quarters as "moderate" repurchasers, in one quarter as

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[1] Jagannathan, Stephens, and Weisbach (2000) and Guay and Harford (2000) show that dividends are implicitly permanent commitments, while repurchases provide firms with financial flexibility, as they do not commit firms to future payouts. Dittmar (2000) examines various motives for repurchases and concludes that signaling undervaluation is a consistent predictor across time. Vermaelen (1984) and Ofer and Thakor (1987) suggest that firms repurchase to disclose privately held information by managers. Peyer and Vermaelen (2009) show that the positive long-run returns following repurchases have persisted across time. Kahle (2002) finds that firms repurchase to mitigate dilution in EPS on account of grants and exercises of employee stock options.

"infrequent" repurchasers, and in zero quarters as "no repurchases." The fraction of all repurchasers classified as infrequent declines from 43% in 1991 to 21% in 2016, while the percentage of frequent repurchasers increases from 27% in 1991 to 55% in 2016.[2] Further, the number of repurchasers increased sharply between 2003 and 2007, which coincides with the growth in frequent repurchasers. Farre-Mensa, Michaely, and Schmalz (2014) find that flexibility and signaling fail to explain the recent surge in repurchases. If frequent repurchasers are less likely to repurchase for signaling and flexibility, then their increasing proportion potentially explains why these motives do not explain the growth in repurchases.

I begin by examining the characteristics of frequent versus infrequent repurchasers. Prior studies find that smaller and younger firms with variable income and high investments prefer repurchases to dividends (Fama and French, 2001; Guffey and Schneider, 2004). While infrequent repurchasers exhibit these characteristics, frequent repurchasers are mature companies with stable earnings, high profitability, and low investments. Thus, frequent repurchasers are similar to traditional dividend payers. I then examine whether repurchase frequency can help distinguish between the three well-known motivations of repurchases: flexibility, signaling, and dilution.

I start with the flexibility motive of repurchases. I hypothesize that repurchases by frequent firms have characteristics similar to dividends and that such firms engage in repurchase smoothing. To test this hypothesis, I first examine the extent to which firms vary repurchases with changes in earnings. I find that frequent repurchasers are significantly more averse to reducing repurchases; they reduce repurchases in 29% of the years in which earnings decline, compared to 51% for infrequent repurchasers. I then estimate Lintner-model regressions for repurchases to examine whether frequent repurchasers are slower to respond to changes in earnings. My estimated speed

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[2] The decline in infrequent repurchasers is despite a sharp increase in the number of repurchasers. The percentage of US firms that repurchase in a year has increased from 25% in 1991 to 51% in 2016.

of adjustment coefficient for frequent repurchasers is 0.28, significantly lower than the coefficient of 0.54 for infrequent repurchasers. This difference indicates that frequent repurchasers take more time to change repurchases with changes in earnings.[3]

As a final test for flexibility, I examine the effect of income permanence on payout decisions. Jagannathan, Stephens, and Weisbach (2000) show that repurchases are more flexible than dividends because firms use dividends to distribute permanent income and use repurchases to distribute temporary income. I extend this analysis by differentiating between repurchases by frequent and infrequent firms. My results show that frequent firms behave like dividend payers and use repurchases to distribute permanent income. They are more likely to increase repurchases when operating income increases but are less likely to do so when income volatility increases. In comparison, infrequent firms are less likely to increase repurchases when operating income increases and more likely to increase repurchases when income volatility increases. Overall, these results indicate that frequent repurchasers engage in repurchase smoothing and use repurchases to distribute permanent income, similar to dividends. Infrequent repurchasers, however, repurchase to distribute temporary and volatile income and adopt a flexible repurchase policy.

Next, I explore the signaling motive of repurchases. I start with the undervaluation aspect of signaling. I create Peyer and Vermaelen's (2009) undervaluation index (U-index), which increases with undervaluation likelihood. Using U-index as a proxy for undervaluation, I find that infrequent repurchasers are more likely to be undervalued and less likely to be overvalued than frequent repurchasers across all periods. I then estimate a logit model to determine the effect of undervaluation on firms' repurchase decisions. I find that compared to frequent repurchasers,

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[3] Lintner (1956) regresses changes in dividends on current earnings and past dividends. The coefficient of past dividends denotes the speed with which firms adjust payouts to changes in earnings. A sticky payout policy implies a lower speed of adjustment as firms do not want to roll back payouts.

infrequent repurchasers are 5.3% more likely to repurchase when undervalued and 8.5% less likely to repurchase when overvalued.

Further, the undervaluation motive implies that firms are more likely to repurchase following negative returns (Kahle, 2002). Therefore, as the next test for undervaluation, I examine abnormal returns around repurchase quarters. The results show that in the quarter prior to repurchases, infrequent repurchasers realize significantly lower abnormal returns than frequent repurchasers (CAPM alpha is lower by 0.48% and FF three-factor alpha is lower by 0.47%). In addition, investors view infrequent repurchases more positively; in the quarter following repurchases, infrequent repurchasers realize 1.1% higher CAPM alpha and 0.71% higher FF three-factor alpha than frequent repurchasers. To mitigate the concerns that my results are driven by mean reversion of returns or differences in firm characteristics, I regress abnormal returns following repurchases on a repurchase indicator and control for prior returns and firm characteristics. I find that infrequent repurchases are associated with 1.9% higher CAPM alpha and 1.2% higher FF three-factor alpha than frequent repurchases. Thus, my results support the notion that repurchases by infrequent firms are more strongly motivated by undervaluation than repurchases by frequent firms.

Next, I examine the aspect of signaling related to the disclosure of new information. I hypothesize that repurchases by infrequent firms are more informative than repurchases by frequent firms. The higher abnormal returns following repurchases by infrequent repurchasers support my assertion. I build upon these results and conduct the following tests to isolate the information content of repurchases. I begin by comparing five-day cumulative abnormal returns around earnings announcements (EARs) for repurchase and non-repurchase quarters. When firms announce earnings, investors learn about both quarterly operating performance *and repurchases*.

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Since repurchases provide a positive signal about future performance, when firms report earnings above (below) analyst estimates, repurchases provide complementary (contrasting) information about future prospects. Therefore, differences in EARs between repurchase and non-repurchase quarters should proxy for the information content of repurchases. The univariate analysis shows that infrequent repurchasers realize significantly higher EARs in repurchase quarters, compared to non-repurchase quarters. The differences in EARs are even higher when "infrequent" firms report earnings below mean analyst estimates, consistent with "infrequent" firms using repurchases to mitigate adverse market reactions. In contrast, EARs for frequent repurchasers do not vary significantly with repurchases. The results hold in a regression setting after controlling for earnings surprises and firm characteristics.

I next compare post-earnings announcement drifts (PEAD) for repurchase and non-repurchase quarters. Prior studies show that firms with positive (negative) news continue to generate positive (negative) returns for sixty days after the earnings announcements (Ball and Brown, 1968; Foster, Olsen, and Shevlin, 1984; Bernard and Thomas, 1989). If repurchases provide information separate from earnings, the upward drifts should be stronger when positive earnings surprises coincide with repurchases, as repurchases complement the positive news from earnings. Meanwhile, the downward drifts should be weaker for bad news quarters, as the positive effect of repurchases would mitigate the negative effect of weak earnings. Consistent with this hypothesis, I find that abnormal returns following positive earnings surprises that coincide with repurchases show stronger upward drifts for both frequent and infrequent repurchasers. However, the incremental drift for repurchase quarters (versus non-repurchase quarters) is significantly stronger for infrequent repurchasers compared to frequent repurchasers.

The effect of repurchases on drifts is even higher when firms announce earnings below analyst estimates. Though the market initially reacts negatively to weak earnings, the cumulative abnormal returns following repurchases turn positive by the 10th trading day for infrequent repurchasers. In comparison, it takes 22 trading days for the CARs to turn positive for frequent repurchasers. Further, when repurchases coincide with negative earnings surprises, infrequent repurchasers realize an incremental drift of 4.2% (versus non-repurchase quarters), significantly higher than an incremental drift of 1.7% for "frequent" firms. These results show that repurchases conducted by "infrequent" firms convey more information than repurchases by "frequent" firms.

Finally, I explore dilution as the likely motive for frequent repurchasers. Kahle (2002) shows that firms repurchase to offset increases in the number of shares outstanding caused by equity compensation. Because repurchases by frequent firms are spread across the year, they can align their repurchases with the grants and exercises of employee stock options. Therefore, I expect dilution to be a stronger motive for such firms. To test this hypothesis, I regress repurchases on total stock options outstanding, exercised, and granted. Consistent with my assertion, I find that compared to infrequent repurchasers, frequent repurchasers have significantly higher coefficients for total options outstanding and exercised. The results are similar when I use executive stock options instead of options held by all the employees. These results suggest that dilution is a stronger motive for frequent repurchasers than for infrequent repurchasers.

This paper makes several contributions to our understanding of payout policy. First, I show that frequent repurchasers, which constitute more than half of total repurchasers in 2016, repurchase in a manner similar to how they would distribute dividends. They engage in repurchase smoothing and use repurchases to distribute permanent income. Further, their repurchases lack signaling power. Therefore, the increasing proportion of frequent repurchasers can explain the

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findings of recent studies (Farre-Mensa, Michaely, and Schmalz, 2014; Obernberger, 2014; Fu and Huang, 2015) that traditional repurchase motives do not account for the overall growth in repurchases.

Second, I examine variation in repurchase motives within repurchasers. This approach separates me from prior studies (Dittmar, 2000; Brav, Graham, Harvey, and Michaely, 2005; Skinner, 2008), which compare repurchases with dividends to determine repurchase motives. I show that repurchase frequency helps separate firms that repurchase for flexibility and signaling (infrequent repurchasers) from firms that repurchase to control dilution (frequent repurchasers). My results have two key implications. First, factoring in repurchase frequency would make trading strategies exploiting the repurchase anomaly (Peyer and Vermaelen, 2008) more profitable because infrequent repurchasers realize higher repurchase announcement returns, and their repurchases are followed by higher abnormal returns. Second, the effect of repurchases on other corporate decisions such as investments may vary with repurchase frequency.[4]

This paper also adds to the literature that relates repurchase characteristics with repurchase frequency. I extend the findings of Jagannathan and Stephens (2003) by analyzing actual repurchases rather than repurchase announcements. This approach allows me to capture the repurchase activities of firms more precisely. Though the percentage of US firms repurchasing in a year has increased from 30% in 1990 to 51% in 2016, the number of repurchase announcements has declined by 45% during this period. Of the firms that repurchased in 2016, only 26% announced a repurchase plan during the year, compared to 59% in 1990. Thus, announcements alone do not completely capture the repurchase activities of firms anymore. Further, while

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[4] Brav, Graham, Harvey, and Michaely (2005) find that firms may forego value accretive projects to maintain dividends. As frequent repurchasers are reluctant to cut repurchases, their repurchases may affect investments differently than repurchases by "infrequent" firms.

Jagannathan and Stephens (2003) focus on the signaling motive of repurchases, I explore other aspects as well, such as flexibility, dilution, and disclosure of new information.

Finally, my findings shed light on the concentration of market timing in infrequent repurchasers (Dittmar and Field, 2015). While Dittmar and Field (2015) highlight the market timing ability of managers, this paper focuses on both the managerial actions and market reaction to the repurchases. I show that infrequent repurchasers strategically buy back to signal undervaluation and to disclose new information, which leads to positive future returns.

2. Hypothesis development

2.1. Repurchase flexibility and frequency of repurchases

Prior literature suggests that repurchases are more flexible than dividends as firms are penalized for cutting dividends. Lintner (1956) states that the reluctance to cut dividends results in firms engaging in dividend smoothing. Brav, Graham, Harvey, and Michaely (2005) reinforce this theory with survey evidence and document that repurchases provide firms with more flexibility in payouts. Skinner (2008) takes the discussion forward by showing that greater flexibility motivates firms to substitute dividends with repurchases. The key inference from these papers is that firms are not obliged to repurchase regularly. However, Bargeron, Bonaimé, Feng, and Thomas (2017) show that repurchases may not be as flexible as previously thought, and Farre-Mensa, Michaely, and Schmalz (2014) suggest that flexibility does not explain the recent surge in repurchases.

I observe that a new breed of firms that repurchase regularly (frequent repurchasers) has emerged. These firms have become more numerous and constitute 55% of total repurchasers in recent years, up from about 30% in the early 1990's. I examine whether their emergence is driving the findings of studies such as Farre-Mensa, Michaely, and Schmalz (2014) and Bargeron, Bonaimé, Feng, and Thomas (2017).

I use variation in repurchase frequency to explore how repurchase motives vary amongst repurchasers. I propose that when firms repurchase regularly, investors upwardly revise expectations about future repurchases. This increased expectation makes regular repurchasers reluctant to reduce repurchases. Lintner (1956) shows that a sticky dividend policy implies a reluctance to cut dividends and results in firms engaging in dividend smoothing. Extending this argument to repurchases, I hypothesize that firms that follow an inflexible/sticky repurchase policy (frequent repurchasers) are reluctant to reduce repurchases and engage in repurchase smoothing.

Jagannathan, Stephens, and Weisbach (2000) and Guay and Harford (2000) suggest that dividends are an ongoing commitment, while repurchases do not commit firms to future payouts. Thus, repurchases provide firms with financial flexibility. As a result, firms pay dividends to distribute permanent and stable income, and they repurchase to pay out transient and volatile earnings. I extend this approach to compare the flexibility of repurchases by frequent and infrequent repurchasers. I propose that firms that follow a flexible repurchase policy (infrequent repurchasers) repurchase in a traditional manner and buy back stock using temporary and volatile income. Meanwhile, firms that follow a rigid repurchase policy (frequent repurchasers) repurchase using permanent income. Therefore, frequent repurchasers are more likely to increase repurchases with increases in operating income, and infrequent repurchasers are more likely to increase repurchases with increases in non-operating income and income volatility.

2.2. *Signaling and frequency of repurchases*

A vast literature documents that signaling is a key motive for repurchases, from Comment and Jarrell's (1991) early work on announcement day returns to studies of long-run performance (Ikenberry, Lakonishok, and Vermaelen, 1995; Ikenberry and Vermaelen, 1996). Peyer and Vermaelen (2009) show that positive long-run returns following repurchases have persisted across

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time. There are two aspects of signaling: undervaluation and new information disclosure. Both of these aspects can explain the positive returns following repurchases. Dittmar (2000) examines a wide array of motives for repurchases and finds that undervaluation is a consistent predictor across time. Vermaelen (1984) and Ofer and Thakor (1987) suggest that firms repurchase to disclose privately held information by managers. However, Obernberger (2014) and Fu and Huang (2015) show that long-term returns following repurchase announcements have disappeared during the last decade.

Recent literature shows that firms' ability to time their repurchases varies considerably with repurchase frequency. Dittmar and Field (2015) and Ben-Rephael, Oded, and Wohl (2013) find that market timing of repurchases is concentrated among infrequent repurchasers. Bonaimé, Kahle, Moore, and Nemani (2017) also suggest that repurchases by "frequent" firms are unlikely to be affected by prior returns. Consistent with these findings, I hypothesize that infrequent repurchasers are more likely to repurchase for signaling purposes.

First, I focus on the undervaluation aspect of signaling. The undervaluation motive states that firms are more likely to repurchase when their stock is undervalued. Therefore, I predict that repurchase decisions of infrequent repurchasers are more strongly correlated with undervaluation than are those of frequent repurchasers. An examination of returns around repurchase quarters sheds further light on the undervaluation motive. Kahle (2002) proposes that undervaluation implies negative returns in the year prior to repurchases. In addition, if investors view repurchases as a credible signal of undervaluation, returns following repurchases should be positive. As a result, I hypothesize that repurchases by "infrequent" firms are preceded by negative returns and followed by positive returns. In comparison, frequent repurchasers realize stronger returns prior to repurchases and weaker returns following repurchases.

Next, I focus on the new information disclosure aspect of signaling. Firms with high information asymmetry repurchase to disclose privately held information to investors (Ofer and Thakor, 1987). Prior studies find that firms that are smaller, have lower institutional ownership, and are followed by fewer analysts have higher information asymmetry (Elliott, Morse, and Richardson, 1984; Atiase, 1985; Freeman, 1987; Bhushan, 1989). Barth and Kasznik (1999) show that firms with higher information asymmetry realize higher repurchase announcement returns. Consequently, I hypothesize that infrequent repurchasers realize higher repurchase announcement returns than frequent repurchasers do.

I then examine the information content of actual repurchases. Prior literature documents that earnings announcement returns are positively associated with firm performance (Bartov, Givoly and Hayn, 2002; Kinney, Burgstahler and Martin, 2002), which means that the market reacts positively to earnings above analyst estimates and negatively to earnings below analyst estimates. When firms announce earnings, investors learn about both operating performance and *repurchases* during the quarter. Consequently, the differences between earnings announcement returns (EARs) of repurchase and non-repurchase quarters should be positively associated with the information content of repurchases. Therefore, I predict that infrequent repurchasers realize higher EARs during repurchase quarters than during non-repurchase quarters. Frequent repurchasers, however, should realize similar EARs during both repurchase and non-repurchase quarters.

I then propose that the signaling effect of repurchases are more pronounced during quarters of weak earnings, as the market reacts more to negative news than to positive news (Skinner and Sloan, 2002). Therefore, firms would be more likely to repurchase for signaling purposes when actual earnings are below analyst estimates. This likelihood leads to the prediction that the

differences in EARs between repurchase and non-repurchase quarters are even higher for quarters with negative earnings surprises.

As a final way to gain insight about the information content of repurchases, I compare post-earnings announcement drifts (PEADs) for repurchase and non-repurchase quarters. Prior studies show that cumulative abnormal returns continue to drift upward for "good news" firms and down for "bad news" firms (Ball and Brown, 1968; Foster, Olsen, and Shevlin, 1984; Bernard and Thomas, 1989). These studies point to delayed incorporation of information from earnings announcements as a possible explanation for PEADs. If repurchases provide information separate from earnings, the drifts following repurchase and non-repurchase quarters should be different. When repurchases coincide with good news (strong earnings), the drifts should move further upwards as they provide complementary positive information. Meanwhile, when repurchases coincide with bad news (weak earnings), the downward drifts should be smaller as the positive effect of repurchases would mitigate the negative effect of weak earnings. Since I expect repurchase by infrequent repurchasers to be more informative than repurchases by infrequent repurchasers, infrequent repurchasers should realize a stronger difference in drifts between repurchase and non-repurchase quarters.

2.3.   *Dilution and frequency of repurchases*

Kahle (2002) and Fenn and Liang (2001) show that employee compensation has a significant effect on the quantum of repurchases and the choice between repurchases and dividends. The grants and exercises of employee stock options increase the number of diluted (basic) shares outstanding, which in turn leads to lower diluted (basic) earnings per share. By repurchasing, firms can offset the increases in the shares outstanding and prevent the dilution of earnings per share and control. I propose that firms that repurchase for dilution need to align

repurchases with the grants and exercises of stock options. Dilution should therefore be a greater motivator for frequent repurchasers than for infrequent repurchasers.

3. Data and key variables

3.1. Data

I begin with all firms in the CRSP-Compustat merged database from 1990 through 2016 and exclude financial and utility industries (SIC codes 4000-4999 and 6000-6999) and firm-years with missing or negative total assets. I use annual Compustat data for tests of the flexibility and the undervaluation motives of repurchases. My final sample consists of 161,647 firm-years. I use quarterly Compustat data to calculate repurchase frequency and Institutional Brokers' Estimate System (I/B/E/S) for analyst earnings estimates. I source open market repurchase announcements between 1990 and 2016 from Security Data Company's (SDC) Mergers and Acquisition database. I exclude all announcements that lack data on Compustat or CRSP. This exclusion results in a sample of 15,602 announcements. To minimize the effect of outliers, all continuous variables are winsorized at the 1st and the 99th percentile.

To test the dilution hypothesis, I use data from two sources. I obtain executive options data from Execucomp for a sample of 39,446 firm-years over the period 1992 to 2016. However, Execucomp reports data for S&P 1500 firms only. Therefore, I also use total employee stock options data from Compustat, which covers all firms. However, this data is available from 2004 onwards. The Compustat sample consists of 37,324 firm-years over the period 2004 to 2016.

Following Banyi, Dyl, and Kahle (2008), I measure repurchases as the purchase of common and preferred stock (*prstkc*) minus any reduction in the value of preferred stock outstanding (*pstkrv*). For quarterly repurchases, I first calculate quarterly purchase of common and

preferred stock (*prstkcy* for the 1st quarter and *prstkcy – lag(prstkcy)* for the 2nd, 3rd, and 4th quarter) and then subtract the reduction in preferred stock outstanding (*pstkq*).

3.2. Key variables

3.2.1. Frequent, moderate, and infrequent repurchasers

The percentage of repurchasing firms that announce a repurchase plan in a year has declined from 59% in 1991 to 26% in 2016. Because firms have become less likely to announce repurchase plans, I depart from Jagannathan and Stephens (2003) and classify firms according to *actual* repurchase frequency as opposed to repurchase *announcement* frequency.[5] In each fiscal year, I classify firms that repurchase during three or more quarters as "frequent" repurchasers, firms that repurchase during two quarters as "moderate" repurchasers, firms that repurchase during one quarter as "infrequent" repurchasers, and firms that do not repurchase as "no repurchases."

My definition is distinct from Skinner (2008), who defines firms that repurchase during five or more of the last ten years as "regular" repurchasers and four or fewer of the last ten years as "occasional" repurchasers. His definition keeps firms in the same category during a decade, allowing comparison of dividend and repurchase policy over time. However, my definition allows firms to change categories depending on their behavior in a year, which allows for analysis of within firm variation in repurchase motives with changes in repurchase frequency.

My approach is similar to Dittmar and Field (2015), who use monthly repurchase data to classify firms that repurchase in at least nine months per year as "frequent" repurchasers, five to eight months per year as "moderate" repurchasers, and one to four months per year as "infrequent"

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[5] Jagannathan and Stephens (2003) classify firms that announce repurchases for the first time in the last five years as "infrequent" repurchasers, two times in the last five years as "occasional" repurchasers, and three or more times in the last five years as "frequent" repurchasers. As announcements have become less common, most firms would now be classified as infrequent as per their definition. Only 11% of the firms defined as frequent repurchasers by my definition would be classified as frequent by theirs.

repurchasers. My definition, which uses quarterly Compustat data, enables study over a longer period because firms started reporting monthly repurchases in 2004. In addition, my approach allows better association between repurchase frequency and firm characteristics, as Compustat data is available at a quarterly frequency.

If infrequent repurchasers exhibit seasonality (i.e., they buy back stock in the same quarter every year), then my argument that infrequent repurchases are unexpected is weakened. However, I find that only 33.3% of infrequent repurchasers repurchase in the same fiscal quarter for two consecutive years, and only 17.5% for three consecutive years. As infrequent repurchasers buy back in different quarters in different years, seasonality is less likely to affect my results.[6]

3.2.2. *Undervaluation index*

I create an undervaluation index (U-index) which is positively associated with undervaluation. As in Peyer and Vermaelen (2009), the U-index is based on size (measured by market value of equity in 2016 dollars), book-to-market ratio, and prior six month returns. These three variables are associated with undervaluation and can predict higher future returns. I calculate U-index as the sum of quintile ranks of size (smallest: 5, largest: 1), past returns (lowest: 5, highest: 1), and book-to-market ratio (highest: 5, lowest: 1). Thus, the index can take a minimum value of three and a maximum value of 15. I further define firms with U-index > 10 as undervalued and U-index < 6 as unlikely to be undervalued (more likely to be overvalued).

I exclude Peyer and Vermaelen's (2009) fourth measure, "purpose of repurchase announcements," since my analysis focuses on actual repurchases. Further, I determine quintile ranks using all firm-years, rather than determining ranks every year. My approach allows

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[6] Table OA1 details the likelihood of a firm repurchasing in the same fiscal quarter in two consecutive years.

comparison of undervaluation across time by allowing more firms to be undervalued during years in which the market as a whole is underperforming.

4. Descriptive statistics

Table I presents the summary statistics for firms in my sample. Based on their activity during the year, I divide all firm-years into two broad categories: repurchasers and non-repurchasers. I further divide repurchasers into infrequent, moderate, and frequent repurchasers and divide non-repurchasers into firm-years with zero and positive dividends. Summary statistics reveal that compared to infrequent repurchasers, frequent repurchasers are almost double in size, have higher and more stable operating income, pay more to shareholders, have higher profitability, and invest less. Thus, frequent repurchasers are large, mature firms with stable income – characteristics usually associated with dividend payers.

Figure 1 shows that the fraction of repurchasers that repurchase infrequently has declined from 43% in 1991 to 21% in 2016. During the same period, the fraction of repurchasers that buy back frequently has increased from 27% to 55%. Further, Figure 2 indicates that the surge in repurchases between 2003 and 2007 coincides with the growth in frequent repurchasers. Thus, the growth in repurchases may be driven by firms that repurchase frequently.

5. Empirical results

5.1. *Determinants and persistence of repurchase frequency*

Table II estimates an ordered logit model to predict repurchase frequency based on the prior year's frequency and firm characteristics. Model 1 shows that for a one standard deviation increase in operating income, log(age), and log(market capitalization), the odds of a firm repurchasing more frequently increase to 2.0, 1.3, and 1.2, respectively. In contrast, for a one standard deviation increase in operating income volatility, capital expenditure, and leverage, the

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odds of a firm repurchasing more frequently reduce to 0.89, 0.85, and 0.80, respectively. Thus, firms with high operating income, low income-volatility, large size, and high profitability are more likely to repurchase frequently. These results are consistent with the assertion that frequent repurchasers have characteristics similar to traditional dividend payers.

Model 2 includes the prior year's frequency along with firm characteristics. Inclusion of the prior year's frequency increases the explanatory power of the model significantly: The pseudo R-squared increases from 0.07 to 0.22. Further, the coefficient of prior frequency is positive and significant, which implies that repurchase frequency is a persistent characteristic. The odds of repurchasing frequently next year are 2.3 times greater for frequent repurchasers than firms repurchasing moderately or infrequently. To control for time invariant industry characteristics, I include Fama-French 48 industry dummies and year dummies in model 3. Model 4 includes industry-year dummies to control for time varying industry shocks. Model 5 excludes recessionary years (2002, 2003, and 2009) to verify that the results are not driven by firms reducing repurchases during recessions. In model 6, I estimate a logit model, with the dependent variable equaling one for frequent repurchasers and zero otherwise, and include firm and year dummies. My conclusions remain unchanged with firm fixed effects. Thus, I provide a stronger evidence for repurchase persistence as my results are not driven by time invariant firm characteristics. Further, I show that the results hold in the cross-section as well as within firm.

5.2.   *Repurchase flexibility and frequency of repurchases*

5.2.1. *Repurchase smoothing*

Firms are reluctant to cut dividends because investors penalize them for doing so (Lintner, 1956; Brav, Graham, Harvey, and Michaely, 2005). As a result, they adopt a stickier dividend policy by increasing dividends only when permanent income increases and by smoothing dividend

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increases over several years. Extending these arguments, an inflexible repurchase policy translates into firms being less likely to reduce repurchases and taking more time to adjust repurchases to earnings changes (i.e., a lower speed of adjustment coefficient in Lintner-model regressions).

Figure 3 presents the relation between changes in earnings and changes in payouts for frequent versus infrequent repurchasers. Panel A reports the fraction of years in which firms increase repurchases, conditional on earnings increases; and Panel B reports the fraction of years in which firms reduce repurchases, conditional on an earnings decline. I hypothesize that frequent repurchasers are reluctant to reduce repurchases when earnings decline, while infrequent repurchasers are more willing to do so, as they follow a more flexible repurchase policy. I find that frequent repurchasers increase repurchases in 76% of the years when earnings increase, and infrequent repurchasers increase repurchases in 66% of the years. However, conditional on an earnings decline, frequent repurchasers reduce repurchases in just 29% of the years versus 51% of the years for infrequent repurchasers. Thus, frequent repurchasers increase repurchases when earnings increase, but are reluctant to reduce repurchases even when earnings decline – a behavior usually associated with dividend payers.

As a second test of flexibility, I estimate Lintner-model regressions for repurchases (Equation (1)) and dividends (Equation (2)), respectively.

$$\Delta Repurchase_t = \beta_0 + \beta_1 Earnings_t + \beta_2 Repurchase_{t-1} + u_t \tag{1}$$

$$\Delta Dividends_t = \alpha_0 + \alpha_1 Earnings_t + \alpha_2 Dividends_{t-1} + \varepsilon_t \tag{2}$$

Coefficients β_1 and α_1 measure the relation between earnings and payouts. Coefficients β_2 and α_2 denote the speed of adjustment (i.e., the inverse of time taken to adjust payouts to earnings

changes). A stickier payout policy implies that firms take more time to change payouts in response to changes in earnings, which should be reflected in lower values of α_2 and β_2.

Table III, Panels A and B report the results for repurchases and dividends, respectively. Models 1, 2, and 3 estimate coefficients for infrequent, moderate, and frequent repurchasers, respectively. All models include firm and year fixed effects and cluster standard errors at the firm level. I find that dividends are on average stickier than repurchases. The speed of adjustment coefficients for repurchases are higher than the coefficients for dividends for all firms, which implies that firms take more time to adjust dividends to earnings changes than to adjust repurchases. Further, the coefficients of earnings are also higher for repurchases than for dividends, consistent with Skinner (2008), who finds that dividend smoothing has weakened the association between earnings and dividends.

Since I hypothesize that frequent repurchasers follow a stickier repurchase policy resembling dividends, I expect that their speed of adjustment coefficient will be lower. Consistent with this expectation, I find that their coefficient is 0.28 – significantly lower than 0.54 for infrequent repurchasers. Thus, compared to infrequent repurchasers, frequent repurchasers take more time to adjust repurchases to earnings changes. Conversely, the coefficient of earnings is significantly higher for frequent repurchasers than for infrequent repurchasers. Since coefficient of earnings is the product of the target payout ratio and speed of adjustment, the higher coefficient implies that frequent repurchasers have a higher payout ratio. This higher ratio is to be expected as frequent repurchasers are large and mature firms with high profitability.

Models 4 through 6 test whether firms respond differently to increases and decreases in earnings. I find that infrequent repurchasers have similar speed of adjustment coefficients for increases and declines in earnings. Frequent repurchasers, however, respond faster to earnings

increases than to earnings declines. This result further supports the claims that frequent repurchasers are reluctant to reduce repurchases and that they take more time to adjust repurchases to earnings declines.

Overall, my results show that infrequent repurchasers follow a more flexible repurchase policy than frequent repurchasers do. Frequent repurchasers are reluctant to cut repurchases even when earnings decline, and they take more time to adjust repurchases to earnings changes. Thus, repurchases by frequent repurchasers exhibit characteristics usually associated with dividends.

5.2.2. *Relation between permanence of income and payout decisions*

The findings of Linter (1956) and Brav, Graham, Harvey, and Michaely (2005) lead to empirical predictions that firms use dividends to distribute permanent income and use repurchases to distribute transient income. Jagannathan, Stephens, and Weisbach (2000) provide evidence for these predictions by showing that firms pay dividends to distribute operating income and use repurchases to pay out non-operating and volatile income. I extend this approach to test how repurchase flexibility varies with repurchase frequency.

I estimate a multinomial logit model to calculate the likelihood of increasing dividends, increasing repurchases, or both in response to changes in operating income, non-operating income and income volatility. I include changes and levels of operating income, non-operating income, income volatility, standard firm characteristics, and year and Fama-French 48 industry dummies. I hypothesize that repurchases by frequent repurchasers resemble dividends. Therefore, frequent repurchasers would be more likely to increase repurchases with increases in operating income and would be less likely to increase repurchases with increases in non-operating income and income volatility. In contrast, infrequent repurchasers would be more likely to increase repurchases with increases in non-operating income and income volatility.

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Table IV outlines the results of the multinomial logit estimation with respect to the category "no increase in payouts." Models 1, 2, and 3 report the log odds of a firm increasing both dividends and repurchases, increasing repurchases but not dividends, and increasing dividends but not repurchases, respectively. I interact earnings variables with indicators for frequent, moderate, infrequent, and no repurchases. F-tests outline the significance of differences between frequent and infrequent repurchasers. The results show that frequent repurchasers are likely to increase both dividends and repurchases when operating income increases, but do not increase either dividends or repurchases when income volatility increases. In comparison, moderate and infrequent repurchasers are significantly less likely to increase repurchases when operating income increases, and are more likely to increase repurchases when income volatility increases. Thus, frequent repurchasers use both dividends and repurchases to distribute permanent income, while infrequent repurchasers use dividends to distribute permanent income and use repurchases to distribute volatile income.

I include the log of market capitalization, the log of age, institutional ownership, and other firm characteristics to control for factors such as size, firm life-cycle, and profitability. Further, there is a sharp jump in the number of firms repurchasing infrequently during the recessionary years (2002, 2003, and 2009). Therefore, models 4 through 6 exclude these three years from the sample and show that the recessions are not driving the results.

In summary, Tables III and IV support my hypothesis that frequent repurchasers follow a stickier repurchase policy. They are reluctant to cut repurchases, take more time to respond to earnings changes, and are less likely to use repurchases to distribute volatile earnings. However, infrequent repurchasers follow a more flexible repurchase policy. They are willing to cut repurchases when earnings decline, respond to earnings changes faster, and increase repurchases

with increases in income volatility. Thus, infrequent repurchases are consistent with a traditional repurchase policy, while frequent repurchases are similar to a typical dividend policy.

5.3. Signaling undervaluation

5.3.1. Undervaluation and repurchase decisions

Firms that repurchase to signal undervaluation are more likely to repurchase after poor prior returns. However, lower prior returns do not capture undervaluation fully. Therefore, I follow Peyer and Vermaelen (2009) to create an undervaluation index, which is the sum of the quintile ranks of size, prior returns, and book-to-market ratios. The U-index can take a value between 3 and 15. Further, I define firms to be undervalued if U-index > 10 and overvalued if U-index < 6.

Figure 4 demonstrates that, as measured by the U-index, firms have become less likely to be undervalued over time. Almost 30% of the repurchasers in the United States were undervalued in early 1990's; but only 13% in 2016. While cases of undervaluation increased sharply during 2000–2003 and 2008–2009 (likely due to the dot com bubble and the financial crisis), a declining trend is clearly visible from 1990 to 2016. Trend analysis shows that the likelihood of undervaluation declines by 0.80% per year (*p-value: 0.003*) and the likelihood of overvaluation increases by 0.50% per year (*p-value: 0.005*).

Next, I examine whether undervaluation affects firms' decisions to repurchase in a year. Table V reports the results of a logit estimation with dependent variable equal to one when firms repurchase and zero otherwise. I control for standard firm characteristics and include firm and year dummies. Model 1 interacts U-index variables with indicators for frequent, moderate, infrequent, and no repurchases. F-tests outline the significance of differences between frequent and infrequent repurchasers. I find that repurchase decisions of frequent repurchasers are not associated with undervaluation. However, moderate and infrequent repurchasers are more likely to repurchase

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when undervalued. Compared to frequent repurchasers, infrequent repurchasers are 5.3% more likely to repurchase when undervalued and 8.5% less likely to repurchase when overvalued. Results are even stronger for "no repurchases" firms. Compared to frequent repurchasers, "no repurchases" firms are 7.1% more likely to repurchase when undervalued and 10.7% less likely to repurchase when overvalued. Since "no repurchases" firms are an extreme case of infrequent repurchasers, this result further affirms that the undervaluation motive declines with repurchase frequency.

Model 2 uses Tobin's q as an alternate measure of undervaluation (lower Tobin's q implies undervaluation). I find that repurchase decisions of infrequent repurchasers are more negatively associated with Tobin's q than frequent repurchasers. Overall, the results in Table V establish that infrequent repurchasers are more likely to be motivated by undervaluation than frequent repurchasers.

5.3.2. Quarterly returns around repurchases: univariate analysis

Next, I analyze quarterly abnormal returns around repurchases to provide additional evidence for the undervaluation motive. Since infrequent repurchasers are more likely to repurchase for undervaluation, I expect them to realize lower returns in the quarter prior to repurchases and higher returns in the quarter following repurchases.

I use CAPM and Fama-French three-factor models to estimate abnormal returns. Table VI Panel A (Panel B) presents CAPM alphas (three-factor alphas) during the quarter before, during, and after repurchases for infrequent, moderate, and frequent repurchasers, respectively. Infrequent repurchasers realize a negative CAPM alpha of -0.68% (three-factor alpha: 0.37%) during the quarter prior to repurchases and a positive CAPM alpha of 2.3% (three-factor alpha: 2.2%) during the quarter following repurchases. Thus, consistent with undervaluation, infrequent repurchasers

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buy back following lower returns, and investors react positively to their repurchases.[7] Compared to infrequent repurchasers, frequent repurchasers realize 0.48% higher CAPM alpha (three-factor alpha: 0.47%) in the quarter prior to repurchases, consistent with undervaluation being a weaker motive for their repurchases. Further, frequent repurchasers realize significantly lower abnormal returns in the quarter following repurchases than infrequent repurchasers do (CAPM alpha is lower by 1.1% and three-factor alpha is lower by 0.71%).[8]

To provide stronger evidence that higher future returns have been caused by repurchases, I divide future returns into the pre- and the post-earnings announcement periods. Since investors learn about repurchases from earnings announcements, higher returns should be concentrated in the post–earnings announcement period. Indeed, I find that infrequent repurchasers realize a CAPM alpha of 1.4% (three factor alpha: 1.3%) during the post–earnings announcement period, significantly higher than CAPM alphas of 0.67% (three-factor alpha: 0.85%) for frequent repurchasers.

5.3.3. Quarterly returns around repurchases: multivariate analysis

To ensure that the returns in the quarters following repurchases are in response to repurchases and not just mean reversion, I use the following specification:

$$Alpha_{t+1} = \beta_0 + \beta_1 Repurchase\ ind._t + \beta_2\ Prior\ returns_{t-1} + controls + fixed\ effects + \varepsilon_{t+1} \qquad (3)$$

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[7] In untabulated results, I find that for non-repurchase quarters, infrequent repurchasers realize CAPM alpha of 0.71% in the prior quarter and -0.33% in the following quarter. Thus, negative prior returns and positive future returns correspond to repurchase quarters only.

[8] Frequent repurchasers also realize positive returns following repurchases despite these being expected by the investors. This result is consistent with the findings of Bessembinder and Zhang (2015), who show that trading strategies that involve purchasing stocks with high probability of follow-on distributions earn significant positive returns. Thus, the market reacts to even those events that have a high probability of occurrence.

Repurchase indicator equals one for repurchase quarters and zero otherwise. For firms that repurchase for undervaluation, β_1 should be positive. I expect β_1 to decline with increases in repurchase frequency.

Table VII reports the results. Panels A and B use the CAPM model and the Fama-French three-factor model, respectively, to measure abnormal returns. I control for prior returns to mitigate the concerns that mean reversion of returns are driving my results. I also control for firm characteristics and include firm and quarter-year fixed effects to mitigate the effect of time invariant firm characteristics on my results. Models 1, 2, and 3 estimate the coefficients separately for infrequent, moderate, and frequent repurchasers. Model 1 shows that repurchases by infrequent firms are associated with a 2.4% higher CAPM alpha (three-factor alpha: 1.8%) in the next quarter. In comparison, repurchases by frequent firms are associated with a lower CAPM alpha of 0.90% (three-factor alpha: 0.60%).

Model 4 includes all firm-quarters and interacts the repurchase indicator with indicators for frequent, moderate, infrequent, and no repurchases. F-tests outline the significance of differences between frequent and infrequent repurchasers. The results show that β_1 is significantly higher for infrequent repurchasers than frequent repurchasers; this higher value demonstrates that repurchases by infrequent repurchasers are a stronger signal of undervaluation than are repurchases by frequent repurchasers. Further, "no repurchases" are firms that did not repurchase in any quarter in the prior year. Thus, their repurchases are less expected than even those of infrequent repurchasers and, hence, should contain stronger signaling power. Indeed, the effect is stronger for these firms, as their repurchases are associated with 3.1% higher CAPM alpha (three-factor alpha: 2.4%) than frequent repurchasers. This result reaffirms my assertion that signaling power of repurchases is higher for less frequent repurchasers.

In sum, the results in Tables V through VII establish that repurchases by "infrequent" firms are more strongly motivated by undervaluation, compared to repurchases by "frequent" firms.

5.4. Signaling: Disclosing private information

In this section, I examine whether firms' propensity to disclose new information varies with repurchase frequency. Ofer and Thakor (1987) suggest that high information asymmetry firms repurchase to disclose privately held information by managers. Tables I and II show that infrequent repurchasers exhibit characteristics associated with high information asymmetry firms: They are smaller, have lower institutional ownership, and are followed by fewer analysts (Elliott, Morse, and Richardson, 1984; Atiase, 1985; Freeman, 1987; Bhushan, 1989). Therefore, infrequent repurchasers would be more likely to use repurchases to disclose privately held information and reduce the information gap between managers and investors.

5.4.1. Repurchase announcement returns

If infrequent repurchasers are more likely to disclose new information through repurchases, investors should react more positively to their repurchase announcements. Table VIII outlines five-day cumulative abnormal returns around all open market repurchase announcements between 1990 and 2016. The announcement returns for infrequent repurchasers are significantly higher than frequent repurchasers, which implies that repurchase announcements by "infrequent" firms are on average more informative.

5.4.2. Earnings announcement returns: repurchase versus non-repurchase quarters

Next, I analyze earnings announcement returns for frequent and infrequent repurchasers. When firms announce quarterly earnings, investors learn about both operating performance and repurchases. Therefore, if repurchases convey incremental information, earnings announcement

returns should be systematically different for repurchase and non-repurchase quarters. I use Compustat quarterly data to obtain earnings announcement dates for each firm-quarter in my sample. Table IX details five-day cumulative abnormal returns around quarterly earnings announcements (EARs). Fama and French (2000) show that the past performance patterns may affect future performance. To ensure that my results are not driven by past performance, I follow Lie (2005) and adjust EARs with the EARs of the closest size firm in the same SIC two-digit industry. Panels A and B present unadjusted and adjusted EARs, respectively.

I find that infrequent repurchasers realize EARs of 0.36% (adjusted: -0.02%) during non-repurchase quarters. In comparison, they realize significantly higher EARs of 0.71% (adjusted: 0.40%), when they repurchase. Meanwhile, frequent repurchasers realize statistically similar EARs for repurchase and non-repurchase quarters. Thus, repurchases by only infrequent firms provide incremental information to investors, which is distinct from the operating information contained in the earnings announcements.

Next, I analyze EARs separately for quarters with positive and negative earnings surprises. Skinner and Sloan (2002) find that the stock market reacts more to negative news than to positive news. Therefore, firms would be more likely to repurchase for signaling when actual earnings are below analyst estimates, as repurchases can mitigate the negative market reaction to weak earnings. For negative earnings surprises, infrequent repurchasers realize incremental EARs of 0.40% (adjusted: 0.44%) in repurchase quarters, which is significantly higher than the incremental returns of 0.17% (adjusted: 0.32%) for positive earnings surprises. Thus, the market reacts more to repurchases that coincide with negative earnings surprises. Meanwhile, frequent repurchasers realize similar EARs during repurchase and non-repurchase quarters irrespective of earnings

surprises. These results show that repurchases by infrequent repurchasers are more informative than repurchases by frequent repurchasers.

To ensure that the differences in earnings announcement returns reflect the information content of repurchases, I regress earnings announcement returns on a repurchase indicator and control for earnings surprises. The model also controls for standard firm characteristics and includes firm and quarter-year fixed effects. Table X reports the results. Models 1, 2, and 3 estimate the coefficients separately for infrequent, moderate, and frequent repurchasers. Consistent with the prior studies (Bartov, Givoly and Hayn, 2002; Kinney, Burgstahler and Martin, 2002), earnings surprises are positively associated with earnings announcement returns for all firms. Further, infrequent repurchasers realize 0.30% higher EARs in repurchase quarters, while repurchases by frequent firms are not significantly associated with EARs.

Model 4 includes all firm-quarters and interacts the repurchase indicator with indicators for frequent, moderate, infrequent, and no repurchases. F-tests outline the significance of differences between frequent and infrequent repurchasers. The results confirm that the repurchase coefficient is significantly higher for infrequent repurchasers than for frequent repurchasers. In addition, the coefficient is positive and significant for "no repurchase" firms as well, consistent with the assertion that less frequent repurchases are more informative.

5.4.3. *Post-earnings announcement drifts: repurchase versus non-repurchase quarters*

Prior studies use PEADs as a sign of slow incorporation of information contained in earnings announcements. These studies state that the cumulative abnormal returns continue to drift up for "good news" firms and down for "bad news" firms (Ball and Brown, 1968; Foster, Olsen, and Shevlin, 1984; Bernard and Thomas, 1989). I use earnings surprise — the difference between actual earnings and the analyst estimates — as a proxy for news from earnings announcements.

The positive earnings surprises proxy for good news and the negative earnings surprises proxy for bad news. I compare PEADs following repurchase and non-repurchase quarters to separate the information content of repurchases. Figure 5a and 5b use the market model and the three-factor model to estimate abnormal returns. I chart PEADs separately for frequent and infrequent repurchasers, conditional on repurchases and good/bad news to isolate the information contained in repurchases. Consistent with a complementary positive effect of repurchases, cumulative abnormal returns exhibit a significantly greater upward drift when repurchases coincide with positive earnings surprises. However, the drifts following repurchases are significantly higher for infrequent repurchasers: In repurchase quarters they realize incremental CAPM abnormal returns of 2.6% (three factor model: 2.3%) over 90 trading-days versus 0.31% (three factor model: 0.50%) for frequent repurchasers (p-value of difference: 0.001).

The PEAD literature documents that the cumulative returns drift downwards following bad news. Consistent with a downward drift after negative news, both frequent and infrequent repurchasers realize negative CARs for up to 60 trading days, when repurchases do not coincide with negative earnings surprises. When repurchases coincide with negative earnings surprises, though the market initially reacts negatively to the announcements of weak earnings, cumulative abnormal returns turn positive by the 10th trading day for infrequent repurchasers and by the 22nd trading day for frequent repurchasers. Further, for repurchase quarters, infrequent repurchasers realize incremental abnormal returns of 4.2% (three factor model: 2.9%) over 90 trading days following earnings announcements. The effect is significantly weaker for frequent repurchasers as they realize an incremental drift of just 1.7% (three factor model: 1.4%) in the repurchase quarters. Thus, repurchases by infrequent repurchasers convey more information than repurchases by frequent repurchasers do.

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Overall, my results show that infrequent repurchasers are more likely to repurchase to signal undervaluation and convey new information, both of which lead to higher future returns.

5.5. *Equity compensation (dilution motive) and repurchases*

In this section, I examine the variation in dilution motive with repurchase frequency. I hypothesize that frequent repurchasers are more likely to repurchase to control dilution. To test this hypothesis, I follow Kahle (2002) and regress repurchases on various stock option variables and control for standard firm characteristics.

Table XI, Panel A regresses repurchases on executive options outstanding and executive options granted. Since Execucomp covers S&P 1500 firms and reports data from 1992 onwards, this analysis spans the period 1992 to 2016 and includes 39,446 firm-years. I interact option variables with indicators for frequent, moderate, infrequent, and no repurchases. F-tests outline the significance of differences between frequent and infrequent repurchasers. Since repurchases are measured as a fraction of lagged market capitalization, the dependent variable is restricted between zero and one. Consequently, I use both Tobit and OLS regressions to estimate the coefficients. I first report the Tobit results. To control for time invariant industry characteristics, model 1 includes industry and year dummies. While the coefficients of executive options outstanding is positive and significant for both infrequent and frequent repurchasers, the F-tests show that the coefficient is significantly higher for frequent repurchasers. The coefficient of executive options granted is positive and significant for frequent repurchasers but not for infrequent repurchasers. Thus, my results support dilution as a stronger motive for frequent repurchasers.[9] To ensure that results are not driven by unobserved firm characteristics, I include firm and year dummies in model 2. I find

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[9] "No repurchase" firms have a negative coefficient for executive options outstanding. This result is not surprising since these are smaller firms with low profitability, and Core and Guay (2001) show that firms with cash-flow problems may use option-based compensation to conserve cash.

that for infrequent repurchasers, the coefficients of both executive options outstanding and granted are not significant. In contrast, for frequent repurchasers the coefficients of both executive options outstanding and granted are positive and significant. Thus, firm fixed effects provide support for dilution to be a motive for only frequent repurchasers. To control for time varying industry shocks that may affect repurchases as well as option compensation, I include industry-year dummies in model 3. The results affirm that frequent repurchasers are more likely to be motivated by dilution. Models 4 through 6 report similar results using OLS estimation.

Table XI, Panel B regresses repurchases on total employee stock options outstanding, total options exercised, and total options granted along with controls for standard firm characteristics. I source total employee stock option data from Compustat which include all firms. However, this data is available from 2004 onwards, limiting my analysis to the period 2004 to 2016. Model 1 includes industry and year dummies and shows that frequent repurchasers have higher coefficients for both total options outstanding and options exercised. The coefficients for options granted are insignificant for all firms, which is not surprising as most options are granted at par and may not be EPS dilutive. The results are similar when I include firm and year dummies (model 2) or industry-year dummies (model 3), and when I use OLS estimation (models 4 through 6).

In conclusion, Table XI shows that dilution is a stronger motive for frequent repurchasers than for infrequent repurchasers. These results are consistent with the findings of Bonaimé, Kahle, Moore, and Nemani (2017) that increases in equity compensation make a firm more likely to repurchase frequently. However, this conclusion will be flawed if infrequent repurchasers do not use equity incentives to compensate employees. To mitigate these concerns, I compare option compensation for frequent and infrequent repurchasers. I find that frequent and infrequent

repurchasers have similar levels of total options outstanding; and, contrary to the concerns, infrequent repurchasers have even higher executive options outstanding and granted. [10]

6. Conclusion

This paper shows that the distinction between dividends and repurchases is narrowing for a large number of firms that repurchase frequently. When firms repurchase frequently, investors expect them to continue repurchasing. In turn they adopt a conservative repurchase policy, and their repurchases start to resemble dividends. Meanwhile, infrequent repurchasers follow a relatively flexible repurchase policy and quickly respond to earnings changes. In addition, infrequent repurchasers have higher information asymmetry compared to frequent repurchasers. They disclose privately held information through repurchases to reduce the information gap between managers and investors. Frequent repurchasers, on the other hand, are more likely to repurchase to offset dilution caused by equity compensation.

Finally, the increasing proportion of firms that repurchase frequently can explain the recent findings that repurchases have become less flexible and are less motivated by signaling in recent years. Further, Bonaimé, Kahle, Moore, and Nemani (2017) find that the dilution motive has become stronger over time. This finding is also consistent with the increase in the number of frequent repurchasers whose repurchases are motivated more by dilution.

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[10] Please see Table OA3 for detailed results.

APPENDIX: VARIABLE DEFINITIONS

Compustat (Annual)

Repurchases: The expenditure on the repurchase of common and preferred stock (PRSTKC) minus any reduction in the value of preferred stock outstanding (PSTKRV).

Market capitalization: Shares outstanding (CSHO) times stock price (PRCC_F) at the end of the prior year.

Market-to-book: Market capitalization plus long-term debt (DLTT) plus debt in current liabilities (DLC) plus preferred stock (PSTK), divided by the book value of assets (AT), at the end of the prior year.

Leverage: Sum of long-term debt (DLTT) and short-term debt (DLC), divided by book value of assets (AT), at the end of the prior year.

CAPEX: Capital expenditures (CAPX), divided by total assets (AT), at the end of the prior year.

Dividends: Total common stock dividend (DVC), divided by market capitalization.

Return on assets: Net income (NI) divided by total assets (AT), at the end of prior year.

Operating income: Operating income (OIBDP), divided by total assets (AT), at the end of prior year.

Non-operating income: Non-operating income (NOPI), divided by total assets (AT), at the end of prior year.

Variability of operating income: Standard deviation of operating income during the last five years.

Repurchase increase: Increase in repurchases/total assets (AT) over last year.

Earnings per share increase: Increase in earnings per share (EPSPX) over last year, adjusted for stock splits and stock dividends (ADJEX_F).

Total options exercised: Total number of stock options exercised (OPTEXD) by all employees in the prior year, as a fraction of shares outstanding.

Total options granted: Total number of stock options granted (OPTGR) to all employees in the current year, as a fraction of shares outstanding.

Total options outstanding: Total number of stock options outstanding (OPTOSBY) for all employees at the end of the prior year, as a fraction of shares outstanding.

Compustat (Quarterly)

Repurchase: The expenditure on the repurchase of common and preferred stock (PRSTKCY for the first fiscal quarter and PRSTKCY – lag(PRSTKCY) for the second, the third, and the fourth fiscal quarters) minus any reduction in the value of preferred stock outstanding (PSTKQ).

Infrequent repurchaser: If a firm repurchases during only one quarter in a year.

Moderate repurchaser: If a firm repurchases during two quarters in a year.

Frequent repurchaser: If a firm repurchases during three or more quarters in a year.

No repurchases: if a firm does not repurchase in a year.

Repurchase indicator: An indicator variable equal to one if the firm repurchases during a quarter.

Execucomp

Executive options granted: Number of stock options granted to the top five executives in the current year, as a fraction of shares outstanding.

Executive options outstanding: Number of stock options outstanding for the top five executives at the end of the prior year, as a fraction of shares outstanding.

CRSP

Dividend increase: Increase in regular dividends per share (DIVAMT) over last year. I include distribution codes (DISTCD) 1232, 1242, 1233, 1234, and 1235 to calculate regular dividends. I observe that in 483 cases, CRSP reports five dividends in one year and three dividends in the prior or the following year. In all such cases, I ensure that firms have four dividends per year by either moving the first dividend to the prior year or the last dividend to the later year.

Prior one-year return: Buy and hold return over the prior year.

Repurchase announcement return: Cumulative abnormal returns during the 5-day window around repurchase announcements using market model, where equal-weighted index is used to proxy for the overall market returns, and the estimation period spans from 250 to 10 days prior to the repurchase announcements.

Earnings announcement return: Cumulative abnormal returns during the 5-day window around quarterly earnings announcement using market model, where equal-weighted index is used to proxy for the overall market returns and the estimation period spans from 250 to 10 days prior to the earnings announcements.

Institutional ownership: Shares held by institutional investors as a percentage of total shares outstanding. This measurement is the sum of stakes held by all institutional investors as reported in their quarterly 13(f) reports. The data were purchased from Thomson Financial. All institutions with at least $100 million under management are required to report equity positions (greater than 10,000 shares or $200,000) to the SEC each quarter. Managers with stale reports (i.e., report date unequal to quarter-end date) are excluded for the quarter. The data are also cleaned of obvious reporting errors (e.g., lags in adjustment for stock splits).

Age: Years since the firm appears for the first time in CRSP database.

IBES

Number of analysts: Maximum number of EPS estimates available in IBES during the past one year.

Earnings surprise: Percentage difference in actual earnings per share (ACTUAL) and median analyst estimates (MEDEST).

Figure 1

Trends in repurchase frequency

This figure charts the percentage of repurchasers that repurchase frequently (during three or four quarters in a year) and that repurchase infrequently (during one quarter in a year), from 1990 through 2016.
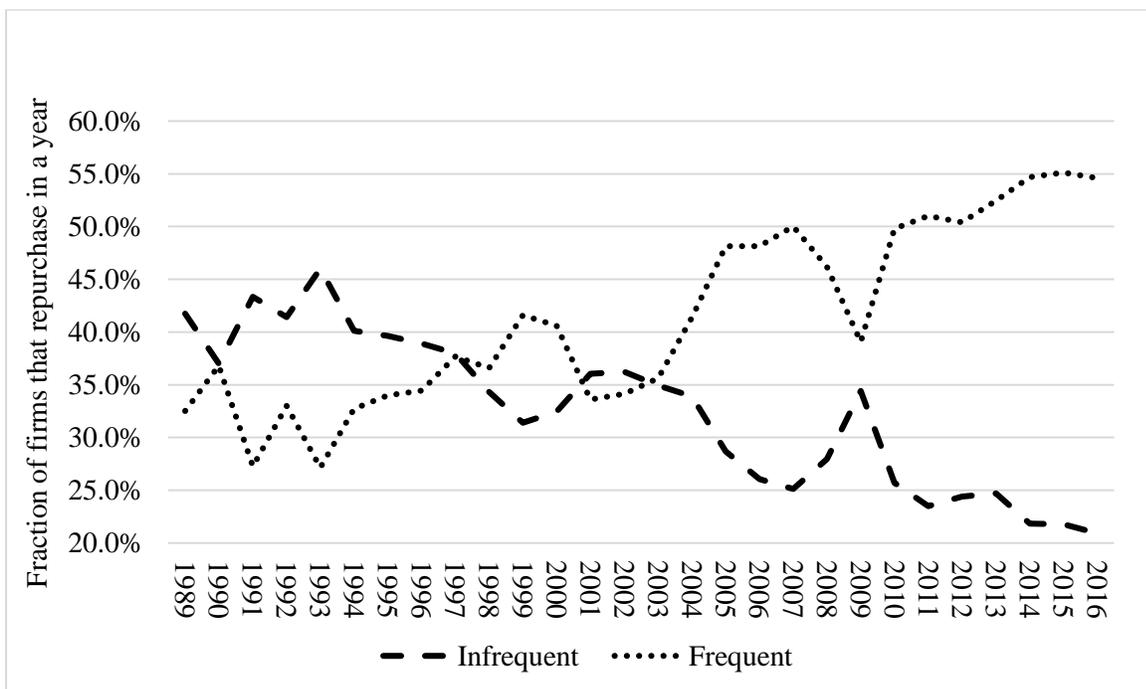
Figure 2

Trends in repurchasing firms

This figure shows the fraction of firms that repurchase in a year for the full sample of listed CRSP/Compustat firms from 1990 to 2016. Repurchases are measured as purchase of common and preferred stock minus any reduction in the value of preferred stock outstanding.
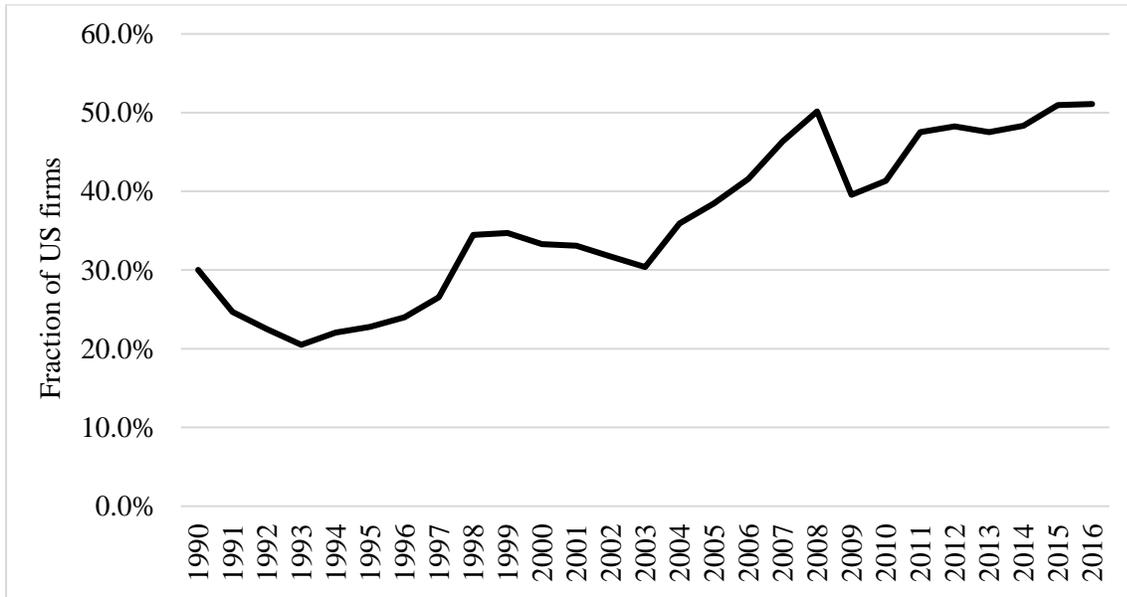
Figure 3

Propensity to change repurchases with changes in earnings

This figure shows the propensity of frequent and infrequent repurchasers to increase (decrease) repurchases with increases (declines) in earnings. Panel A reports the number of years during which firms increase repurchases (versus prior year) as a percentage of total number of years with earnings increases. Panel B reports the number of years during which firms reduce repurchases (versus prior year) as a percentage of total number of years with earnings decline.

Panel A: Propensity to increase repurchases with *increases in earnings*
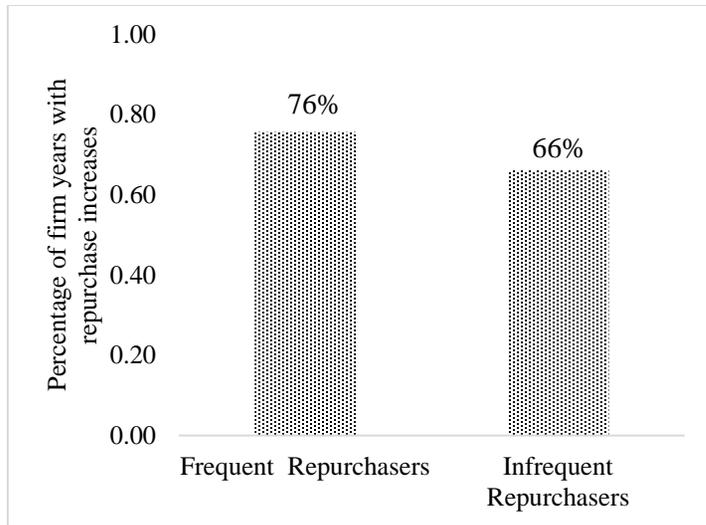
Panel B: Propensity to reduce repurchases with *declines in earnings*
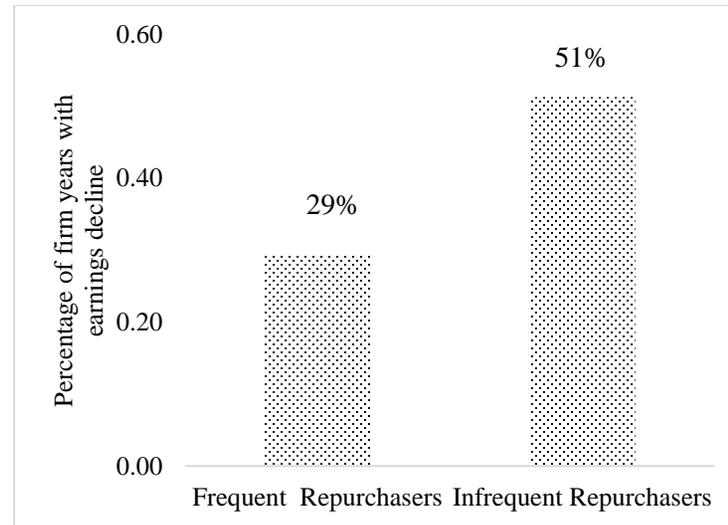
Figure 4

Trend in undervaluation index

This figure plots the percentage of repurchasing firms with an undervaluation index (U-index) < 6 and undervaluation index > 10. The U-index, which is the sum of the quintile ranks of size (5: smallest, 1: largest), book-to-market (5: largest, 1: smallest), and prior year returns (5: lowest, 1: highest), takes a higher value for firms that are more likely to be undervalued.
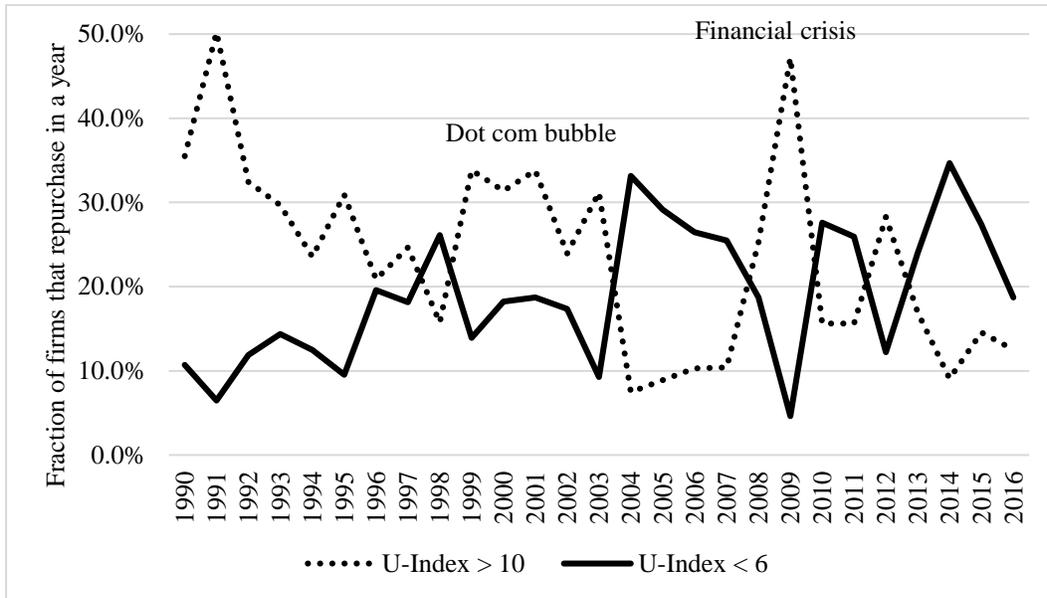
Figure 5a

PEAD for frequent and infrequent repurchasers (Mkt model)

This figure plots cumulative abnormal returns (using market model) following earnings announcements. Panel A presents the CARs for infrequent repurchasers and Panel B for frequent repurchasers. The chart separates CARs into four categories. The first category consists of quarters in which firms do not repurchase and do report earnings below analyst estimates. The second category includes quarters without repurchases and with actual earnings higher than the analyst estimates. The third and fourth categories comprise quarters with repurchases and actual earnings below and above analyst estimates, respectively. ***, **, and * denote significance at 1%, 5%, and 10% respectively.
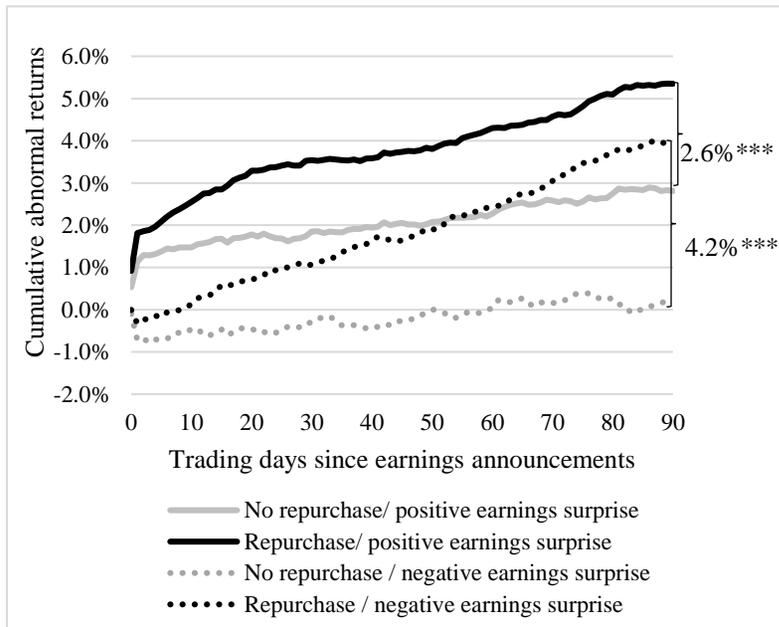
Panel A: PEADs for infrequent repurchasers   **Panel B: PEADs for frequent repurchasers**
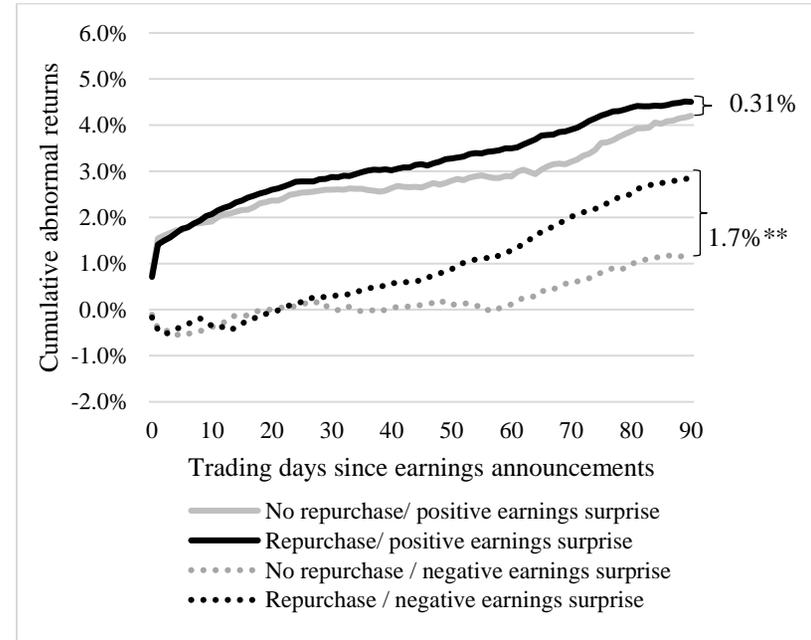
Figure 5b

PEAD for frequent and infrequent repurchasers (Fama-French three-factor model)

This figure plots cumulative abnormal returns (using three-factor model) following earnings announcements. Panel A presents the CARs for infrequent repurchasers and Panel B for frequent repurchasers. The chart separates CARs into four categories. The first category consists of quarters in which firms do not repurchase and do report earnings below analyst estimates. The second category includes quarters without repurchases and actual earnings higher than the analyst estimates. The third and fourth categories comprise quarters with repurchases and actual earnings below and above analyst estimates, respectively. ***, **, and * denote significance at 1%, 5%, and 10% respectively.
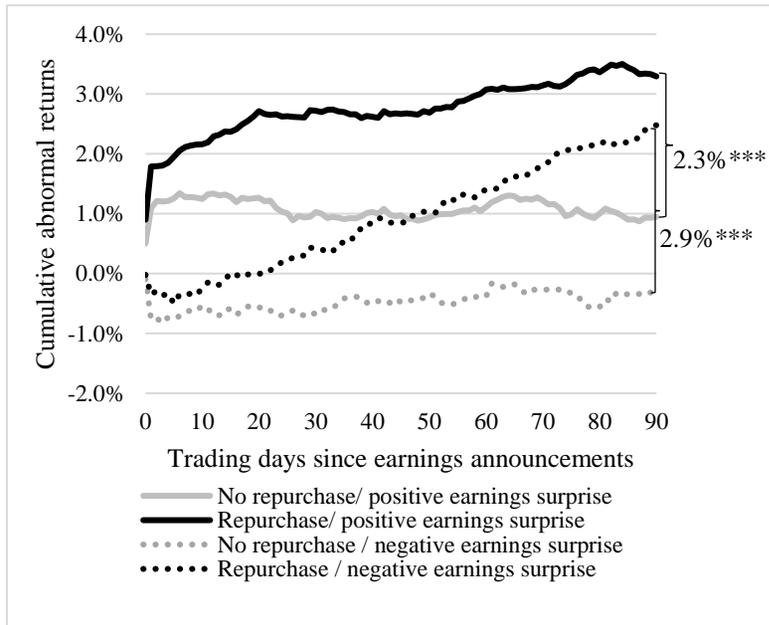
Panel A: PEADs for infrequent repurchasers   **Panel B: PEADs for frequent repurchasers**

Table I

Summary statistics

This table exhibits summary statistics for my sample of 161,647 firm-years between 1990 and 2016. I divide firm-years into two broad categories, repurchases = 0 and repurchases > 0. Furthermore, years with zero repurchases are divided into years with zero dividends and dividend > 0. Repurchasers are divided into three categories: infrequent repurchasers (years in which firms repurchase during one quarter only), moderate repurchasers (years in which firms repurchase during two quarters), and frequent repurchasers (years in which firms repurchase during three or more quarters). Repurchases and dividends are expressed as a percentage of market capitalization; and operating income, non-operating income, capex, and leverage are expressed as a percentage of total assets. Return on assets and institutional ownership are in percentages. The last two columns present the differences between frequent and infrequent repurchasers, and between infrequent repurchasers and dividend payers; ***, **, and * denote significance at 1%, 5%, and 10% respectively. Please refer to the appendices for detailed variable definitions.

	Repurchase = 0		Repurchases >0			Frequent - infrequent	Infrequent - dividend >0
	Dividend =0	Dividend>0	Infrequent	Moderate	Frequent		
Assets (2016 $ million)	1,186	8,969	4,944	5,691	9,768	*4824****	*-4025****
Operating income	-3.5	10.09	7.61	9.61	13.01	*5.41****	*-2.48****
Non-operating income	0.93	0.42	0.71	0.68	0.62	*-0.10****	*0.29****
Operating income volatility	10.14	2.91	5.42	4.62	3.78	*-1.63****	*2.51****
Return on assets	-13.66	3.54	-1.29	1.10	4.69	*5.98****	*-4.83****
Capital expenditure	5.64	4.09	5.07	4.62	4.29	*-0.78****	*0.98****
Leverage	15.82	18.78	22.93	20.98	19.67	*-3.26****	*4.15****
Market-to-book	2.02	1.14	1.40	1.36	1.49	*0.10****	*0.26****
Repurchases	-	-	1.60	2.93	4.93	*3.33****	*1.60****
Dividends	-	3.63	1.40	1.48	1.50	*0.10****	*-2.23****
Dividends >0	-	100.00	43.47	49.76	59.81	*16.33****	*-56.53****
Age	8.87	16.60	14.90	17.06	20.60	*5.70****	*-1.70****
Institutional ownership	31.4	40.60	45.00	49.73	55.08	*10.08****	*4.40****
Prior one-year return	13.93	14.47	11.92	12.90	15.49	*3.57****	*-2.55****
Number of analysts	5.5	6.07	7.09	8.02	10.27	*3.18****	*1.02*
Number of observations	74,161	38,112	16,833	13,567	18,974		

Table II

Ordered logit and logit estimation of repurchase frequency

Models 1 through 5 present the results of an ordered logit model with dependent variable equaling 0 for years with no repurchases, 1 for infrequent repurchasers, 2 for moderate repurchasers, and 3 for frequent repurchasers. First two models include year dummies and the third model includes industry (Fama-French 48 industries) and year dummies. Models 4 and 5 include industry-year dummies. The fifth model excludes recessionary years (2002, 2003, and 2009). Model 6 uses logit estimation with dependent variable as one for frequent repurchasers and zero otherwise. It includes firm and year dummies. Standard errors are clustered by firm. All independent variables are defined in the appendices. T-statistics are in parentheses; ***, **, and * denote significance at 1%, 5%, and 10% respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Prior frequency		0.817***	0.797***	0.796***	0.796***	0.716***
		(125.73)	(121.50)	(115.43)	(111.44)	(29.94)
Operating income	3.085***	1.702***	1.384***	1.360***	1.396***	2.103***
	(19.93)	(15.27)	(12.06)	(11.64)	(10.61)	(8.83)
Non-operating income	0.000	-0.001	-0.001	-0.002	-0.003	-0.002
	(0.36)	(-0.66)	(-0.84)	(-0.99)	(-1.13)	(-0.46)
Income Volatility	-1.198***	-0.625***	-0.743***	-0.658***	-0.607***	-0.910***
	(-6.17)	(-4.78)	(-5.29)	(-4.59)	(-4.03)	(-2.73)
Log (Mkt cap)	0.100***	0.080***	0.107***	0.114***	0.120***	0.522***
	(10.24)	(13.62)	(17.21)	(17.24)	(17.51)	(23.29)
Market-to-book	-0.045***	-0.021***	-0.039***	-0.037***	-0.043***	-0.236***
	(-3.62)	(-2.62)	(-4.52)	(-4.21)	(-4.75)	(-14.03)
Capital expenditure	-2.486***	-1.555***	-1.156***	-1.418***	-1.398***	-2.303***
	(-10.22)	(-9.38)	(-6.58)	(-7.66)	(-7.27)	(-6.42)
Leverage	-0.993***	-0.696***	-0.650***	-0.649***	-0.651***	-1.900***
	(-14.21)	(-15.34)	(-13.58)	(-12.61)	(-12.24)	(-16.24)
Return on assets	0.260**	0.254***	0.367***	0.371***	0.431***	0.825***
	(2.48)	(2.75)	(3.95)	(3.98)	(3.68)	(4.33)
Prior one-year return	-0.207***	-0.019	-0.014	-0.020	-0.038**	-0.160***
	(-13.08)	(-1.22)	(-0.89)	(-1.23)	(-2.18)	(-5.76)
Log(age)	0.185***	0.056***	0.078***	0.085***	0.090***	0.220***
	(10.76)	(5.28)	(7.03)	(7.41)	(7.53)	(6.01)
Institutional ownership	0.702***	0.386***	0.245***	0.316***	0.310***	-0.696***
	(12.43)	(10.73)	(6.44)	(7.90)	(7.40)	(-7.36)
Number of observations	116,107	116,107	116,107	116,107	101,876	62,911
Fixed effects	Year	Year	FF 48/Year	FF48-Year	FF48-Year	Firm/Year
Pseudo R-Squared	0.075	0.223	0.228	0.245	0.247	0.109

Table III
Lintner model regressions for timeliness of changes in payouts with changes in earnings

This table reports Lintner model regressions for repurchases (Panel A) and dividends (Panel B). Models 1, 2, and 3 report the estimates for infrequent, moderate, and frequent repurchasers, respectively. I define firms as frequent/moderate/infrequent based on the repurchase activities in the prior year. Repurchases are defined in section 3.1 and are standardized by total assets (AT); dividends are regular dividends per share from CRSP and earnings per share (EPSPX) and total earnings (EPSPX*CSHO, standardized by total assets) are from Compustat. Models 4 through 6 include interactions of dependent variables with an indicator variable that equals one if increases in earnings are in the top tercile. All models include firm and year fixed effects. Standard errors are clustered by firm. T-statistics are in parentheses; ***, **, and * denote significance at 1%, 5%, and 10% respectively.

Panel A: Linter model regression for repurchases

	Infrequent	Moderate	Frequent	Infrequent	Moderate	Frequent
Total earnings	0.024***	0.041***	0.057***	0.015***	0.025***	0.026**
	(5.67)	(6.43)	(4.49)	(4.27)	(4.85)	(2.41)
Total earnings * earnings increase.				0.004	0.004	0.092***
				(0.84)	(0.47)	(4.63)
Repurchases (Lag)	-0.542***	-0.447***	-0.280***	-0.521***	-0.484***	-0.269***
	(-4.33)	(-10.05)	(-2.71)	(-3.05)	(-11.88)	(-2.85)
Repurchases (Lag) * earnings increase				-0.026	0.104	-0.107***
				(-0.24)	(1.34)	(-2.88)
Earnings increase indicator				-0.000	-0.003	0.005*
				(-0.16)	(-1.12)	(1.89)
Number of observations	13,968	10,944	15,233	13,968	10,944	15,233
Adjusted R-squared	0.197	0.304	0.187	0.197	0.307	0.202

Panel B: Linter model regression for dividends

	Infrequent	Moderate	Frequent	Infrequent	Moderate	Frequent
Earnings per share	0.011***	0.001***	0.010*	0.011***	0.001***	0.010
	(3.70)	(3.03)	(1.69)	(3.49)	(3.00)	(1.35)
Earnings per share * earnings increase				-0.000	-0.000	0.002
				(-0.67)	(-0.17)	(1.00)
Dividends (Lag)	-0.143***	-0.147***	-0.040***	-0.151***	-0.147***	-0.046***
	(-8.51)	(-9.09)	(-2.78)	(-8.67)	(-8.35)	(-3.15)
Dividends (Lag)*earnings increase				0.022	0.000	0.013
				(1.21)	(0.01)	(1.48)
Earnings increase indicator				-0.008*	0.002	-0.002
				(-1.92)	(0.51)	(-0.43)
Number of observations	13,441	10,627	14,865	13,441	10,627	14,865
Adjusted R-squared	0.113	0.124	0.054	0.115	0.124	0.057

Table IV

Permanence of earnings and payout decisions

This table estimates multinomial logit regression to examine the effect of changes in operating income, non-operating income, and income volatility on firms' payout decisions. The dependent variable has four categories: (i) years with increase in both dividends and repurchases, (ii) years with increase in only repurchases, (iii) years with increase in only dividends, and (iv) years with no increase in payout (the base category). Models1 through 3 include all firm-years across 1990 to 2016. Models 4 through 6 exclude recessionary periods (2002, 2003, and 2009). I define firms as frequent/moderate/infrequent/no repurchases based on the repurchase activities in the prior year. All regressions include dummies for infrequent, moderate, and no repurchases and control for levels and changes of log(market cap), return on assets, market-to-book, capex, leverage, institutional ownership, log(age), and prior returns. Regressions also include Fama-French 48 industry and year dummies, and standard errors are clustered by firm. T-statistics are in parentheses and p-values are in brackets; ***, **, and * denote significance at 1%, 5%, and 10% respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Base category: No payout increase			Base category: No payout increase		
	Both increase	Repurchase increase	Dividend increase	Both increase	Repurchase increase	Dividend increase
ΔOperating income*frequent	10.662***	4.493***	2.909***	10.948***	4.616***	3.004***
	(15.97)	(11.32)	(5.02)	(15.24)	(9.86)	(4.71)
ΔOperating income*moderate	6.380***	2.023***	3.221***	6.506***	1.066***	3.511***
	(10.22)	(5.36)	(4.12)	(9.80)	(4.92)	(3.97)
ΔOperating income*infrequent	3.861***	0.314*	1.342*	3.803***	0.571*	1.705**
	(6.40)	(1.87)	(1.87)	(6.04)	(1.83)	(2.16)
ΔOperating income*no repurchases	3.227***	0.325**	2.488***	3.195***	0.229	2.517***
	(7.73)	(1.99)	(7.18)	(7.57)	(1.32)	(6.85)
ΔIncome volatility*frequent	-8.567***	-2.625***	-4.708**	-8.103***	-2.110***	-4.400**
	(-4.53)	(-4.32)	(-2.47)	(-3.93)	(-3.42)	(-2.09)
ΔIncome volatility*moderate	-8.176***	0.812**	-3.211	-8.578***	0.555	-4.308*
	(-4.42)	(2.10)	(-1.44)	(-4.54)	(1.40)	(-1.83)
ΔIncome volatility*infrequent	-8.902***	0.815**	-3.120*	-9.010***	0.672*	-3.524*
	(-4.01)	(2.12)	(-1.75)	(-3.93)	(1.77)	(-1.86)
ΔIncome volatility*no repurchases	-6.447***	1.375**	-4.235***	-6.711***	1.410**	-4.426***
	(-5.34)	(2.24)	(-4.98)	(-5.45)	(2.07)	(-4.81)
ΔNon-operating income*frequent	5.653***	3.904***	4.312***	5.672**	4.198***	4.905***
	(2.94)	(3.97)	(3.02)	(2.48)	(3.43)	(2.63)
ΔNon-operating income*moderate	1.889	3.054***	5.853***	2.081	3.793***	6.112***
	(0.65)	(3.14)	(2.92)	(0.67)	(2.78)	(3.13)
ΔNon-operating income*infrequent	6.396***	3.482**	4.327	6.563***	3.725**	4.960*
	(2.60)	(2.32)	(1.62)	(2.89)	(2.15)	(1.86)
ΔNon-operating income*no repurchases	2.231	3.127***	1.166	2.767*	3.265***	1.101
	(1.53)	(4.23)	(1.11)	(1.80)	(4.08)	(0.98)
F-tests with p-values						
ΔOperating income (freq-infreq)	6.801***	4.179***	1.568*	7.144***	4.045***	1.299
P-value	[0.000]	[0.000]	[0.075]	[0.000]	[0.000]	[0.185]
ΔIncome volatility (freq-infreq)	0.335	-3.440***	-1.588	0.907	-2.782**	-0.876
P-value	[0.904]	[0.008]	[0.523]	[0.553]	[0.029]	[0.344]
ΔNon-operating income (freq-infreq)	-0.743	0.422	-0.015	-0.892	0.473	-0.055
P-value	[0.897]	[0.597]	[0.952]	[0.781]	[0.497]	[0.733]
Number of observations		96,337			84,433	
Industry/year fixed effects/controls		Yes			Yes	
Period		1990-2016			Excludes 2002, 2003, 2009	
Pseudo R-squared		0.196			0.197	

Table V

Undervaluation and decision to repurchase

This table reports logit estimation of the effect of undervaluation index on the decision to repurchase in a year. The dependent variable equals one for years with positive repurchases and zero otherwise. Model 1 details the effect of high (U-index > 10) and low (U-index < 6) undervaluation index on repurchase decisions. Model 2 uses Tobin's q as a proxy for undervaluation. I define firms as frequent/moderate/infrequent/no repurchases based on the repurchase activities in the prior year. All models include dummies for infrequent, moderate, and no repurchases and include controls for log (market capitalization), operating income, return on assets, market-to-book, capex, leverage, institutional ownership, log (age), and prior returns along with year and firm dummies. All independent variables are defined in the appendices. Standard errors are clustered by firm. T-statistics are in parentheses and p-values are in brackets; ***, **, and * denote significance at 1%, 5%, and 10% respectively.

	Model 1		Model 2	
	Coefficient	Marginal effects	Coefficient	Marginal effects
U-Index >10 * frequent	-0.087	-0.026		
	(-1.34)			
U-Index > 10 * moderate	0.102*	0.011		
	(1.82)			
U-Index > 10 * infrequent	0.215***	0.032	`	
	(4.48)			
U-Index > 10 * no repurchases	0.325***	0.049		
	(11.14)			
U-Index < 6 * frequent	0.388***	0.066		
	(4.17)			
U-Index < 6 * moderate	0.059	0.016		
	(0.78)			
U-Index < 6 * infrequent	-0.065	-0.005		
	(-1.04)			
U-Index < 6 * no repurchases	-0.175***	-0.025		
	(-5.42)			
Tobin's q * frequent			-0.120***	-0.021
			(-4.38)	
Tobin's q * moderate			-0.203***	-0.036
			(-9.05)	
Tobin's q * infrequent			-0.200***	-0.036
			(-10.98)	
Tobin's q * no repurchases			-0.178***	-0.032
			(-18.38)	
F-tests with p-values				
U- index >10 (frequent-infrequent)	-0.302***	-0.053		
P-value	[0.001]			
U-index < 6 (frequent-infrequent)	0.453***	0.085		
P-value	[0.000]			
Tobin's q (frequent-infrequent)			0.080***	0.015
P-value			[0.009]	
Number of observations	99,512		99,990	
Firm/year fixed effects/controls	Yes		Yes	
Pseudo R squared	0.171		0.169	

Table VI

Abnormal returns around repurchase quarter

This table compares abnormal returns in the quarters before (Q_{t-1}), during (Q_t), and after repurchases (Q_{t+1}) for all repurchasing firms in my sample. Lead quarter returns are further divided into the pre- and the post-earnings announcement period. Panels A and B calculate abnormal returns using CAPM model and Fama-French three-factor model respectively. I define firms as frequent/moderate/infrequent based on the repurchase activities in the prior year. P-values are in brackets; ***, **, and * denote significance at 1%, 5%, and 10% respectively.

Panel A: CAPM abnormal returns around repurchase quarters

	Q_{t-1}	Q_t	Q_{t+1}		
			Pre-earnings announcement	Post-earnings announcement	Full Quarter
Infrequent	-0.68	0.66	0.90	1.40	2.30
Moderate	-0.53	-0.29	0.65	0.91	1.56
Frequent	-0.20	-0.09	0.54	0.67	1.21
Infrequent - Frequent	-0.48**	0.75***	0.36**	0.83***	1.09***
P-value	[0.049]	[0.001]	[0.011]	[0.004]	[0.000]

Panel B: Fama-French three-factor abnormal returns around repurchase quarters

	Q_{t-1}	Q_t	Q_{t+1}		
			Pre-earnings announcement	Post-earnings announcement	Full Quarter
Infrequent	0.37	1.25	0.94	1.30	2.24
Moderate	0.77	0.90	0.83	0.97	1.80
Frequent	1.04	1.11	0.68	0.85	1.53
Infrequent - Frequent	-0.47***	0.14	0.26	0.45*	0.71**
P-value	[0.002]	[0.448]	[0.260]	[0.089]	[0.026]

Table VII

Do future abnormal returns vary with repurchase frequency?

This table reports the results of the regression of next-quarter abnormal returns on repurchases. Panel A and Panel B use CAPM and FAMA-French three-factor models to estimate abnormal returns. Repurchase indicator equals one for quarters in which firms repurchase. Models 1, 2, and 3 estimate results for infrequent, moderate, and frequent repurchasers, respectively. Model 4 includes all firm-quarters and interacts repurchase indicator variable with indicators for frequent repurchasers, moderate repurchasers, infrequent repurchasers, and no repurchases. I define firms as frequent/moderate/infrequent/no repurchases based on the repurchase activities in the prior year. All models include dummies for infrequent, moderate, and no repurchases and include controls for log(market capitalization), operating income, return on assets, market-to-book, capex, leverage, institutional ownership, log(age), and prior quarter alpha, along with firm and quarter-year fixed effects. Standard errors are clustered by firm. T-statistics are in parentheses and p-values are in brackets; ***, **, and * denote significance at 1%, 5%, and 10% respectively.

Panel A: Effect of repurchases on future CAPM alpha

	CAPM alpha in Quarter $_{t+1}$			
	(1)	(2)	(3)	(4)
	Infrequent	Moderate	Frequent	All firms
Repurchase indicator	0.024***	0.015***	0.009***	
	(6.88)	(4.59)	(3.06)	
Repurchase Indicator * frequent				0.010***
				(4.04)
Repurchase Indicator * moderate				0.021***
				(7.07)
Repurchase Indicator * infrequent				0.029***
				(9.53)
Repurchase Indicator * no repurchases				0.041***
				(17.44)
F-tests with p-values				
Repurchase indicator (freq-infreq)				0.019***
p-values				[0.000]
Number of firm-quarters	46,231	36,716	50,444	418,305
Firm and quarter fixed effects/controls	Yes	Yes	Yes	Yes
Adjusted R-squared	0.132	0.139	0.112	0.122

Panel B: Effect of repurchases on future Fama-French three-factor alpha

	Fama-French three-factor alpha in Quarter$_{t+1}$			
	(1)	(2)	(3)	(4)
	Infrequent	Moderate	Frequent	All firms
Repurchase indicator	0.018***	0.013***	0.006**	
	(5.47)	(3.98)	(2.11)	
Repurchase Indicator * frequent				0.012***
				(5.05)
Repurchase Indicator * moderate				0.020***
				(6.88)
Repurchase Indicator * infrequent				0.024***
				(7.99)
Repurchase Indicator * no repurchases				0.035***
				(15.54)
F-tests with p-values				
Repurchase indicator (freq-infreq)				0.012***
p-values				[0.001]
Number of quarters	46,231	36,716	50,444	418,298
Firm and quarter fixed effects/controls	Yes	Yes	Yes	Yes
Adjusted R-squared	0.107	0.109	0.088	0.101

Table VIII

Repurchase announcement returns for frequent vs. infrequent repurchasers

This table reports cumulative abnormal returns over five days around the announcement date for all open-market repurchases during the period 1990 to 2016. The abnormal returns are estimated using the market model, where equal-weighted index is used to proxy for the overall market returns and the estimation period spans from 250 to 10 days prior to repurchase announcements. I define firms as frequent/moderate/infrequent/no repurchases based on the repurchase activities in the year just prior to the repurchase announcement date. P-values are in brackets; ***, **, and * denote significance at 1%, 5%, and 10% respectively.

	No repurchases	Infrequent	Moderate	Frequent	*Infrequent - Frequent*
Repurchase announcement returns	2.61	2.00	1.39	1.42	*0.58***
P-value of difference					[0.028]
Number of announcements	8,982	1,832	1,762	3,028	

Table IX

Earnings announcement returns for frequent and infrequent repurchasers

This table reports five-day cumulative abnormal returns (CAR [-2, +2]) around the quarterly earnings announcement date for all repurchasers during the period 1990 to 2016. Panel A reports unadjusted EARs. Panel B reports EARs adjusted with the EARs of the closest size firms in the same SIC two-digit industry to control for prior performance. The abnormal returns are estimated using the market model, where equal-weighted index is used to proxy for the overall market returns, and the estimation period spans from 250 to 10 days prior to the earnings announcements. Models 1 to 3 present EARs for infrequent repurchasers and models 4 to 6 show EARs for frequent repurchasers. Models 2 and 3 (5 and 6) detail the returns separately for quarters with positive (actual EPS more than median analyst estimates from IBES) and negative (actual EPS less than median analyst estimates from IBES) earnings surprises. I define firms as frequent /infrequent based on the repurchase activities in the prior year. ***, **, and * denote significance at 1%, 5%, and 10% respectively.

Panel A: EARs for frequent and infrequent repurchasers

	Infrequent repurchasers			Frequent repurchasers		
	All quarters	Earnings surprise ≥ 0	Earnings surprise < 0	All quarters	Earnings surprise ≥ 0	Earnings surprise < 0
Repurchase quarter	0.71	2.01	-0.02	0.59	1.62	-0.21
Non-repurchase quarter	0.36	1.84	-0.38	0.52	1.78	-0.23
Repurchase - No repurchase	0.35***	0.17	0.40**	0.07	-0.16	0.02
P-value	[0.000]	[0.199]	[0.026]	[0.369]	[0.143]	[0.833]

Panel B: Adjusted EARs for frequent and infrequent repurchasers

	Infrequent repurchasers			Frequent repurchasers		
	All quarters	Earnings surprise ≥ 0	Earnings surprise < 0	All quarters	Earnings surprise ≥ 0	Earnings surprise < 0
Repurchase quarter	0.40	1.50	-0.14	0.20	1.09	-0.52
Non-repurchase quarter	-0.02	1.18	-0.58	0.06	1.27	-0.71
Repurchase - No repurchase	0.42***	0.32**	0.44***	0.14	-0.18	0.19
P-value	[0.005]	[0.038]	[0.005]	[0.135]	[0.166]	[0.138]

Table X

Earnings announcement returns and repurchase frequency: multivariate results

This table reports the regression of earnings announcement returns on repurchase indicator that takes a value of one for repurchase quarters. Models 1, 2, and 3 estimate results respectively for infrequent, moderate, and frequent repurchasers. Model 4 uses all firm-quarters and interacts the repurchase indicator with indicators for frequent repurchasers, moderate repurchasers, infrequent repurchasers, and no repurchases. I define firms as frequent/moderate/infrequent/no repurchases based on the repurchase activities in the prior year. Earnings surprise is defined as the percentage difference between actual EPS (ACTUAL) and median analyst estimates from IBES (MEDEST). All models include dummies for infrequent, moderate, and no repurchases and include controls for log(market capitalization), operating income, return on assets, market-to-book, capex, leverage, institutional ownership, log(age), and prior quarter returns, along with firm and quarter-year fixed effects. Standard errors are clustered by firm. T-statistics are in parentheses and p-values are in brackets; ***, **, and * denote significance at 1%, 5%, and 10% respectively.

	Earnings announcement returns			
	(1)	(2)	(3)	(4)
	Infrequent	Moderate	Frequent	All firms
Repurchase indicator	0.003***	0.002*	-0.000	
	(2.85)	(1.94)	(-0.01)	
Repurchase Indicator * frequent				-0.000
				(-0.06)
Repurchase Indicator * moderate				0.002*
				(1.85)
Repurchase Indicator * infrequent				0.002**
				(2.39)
Repurchase Indicator * no repurchase				0.003***
				(3.80)
Earnings surprise	0.124***	0.141***	0.160***	0.127***
	(16.95)	(17.79)	(22.45)	(43.77)
F-tests with p-values				
Repurchase indicator (freq-infreq)				0.003**
p-values				[0.040]
Number of quarters	39,875	32,757	46,930	346,232
Firm and quarter fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.031	0.043	0.045	0.022

Table XI

Repurchases and option compensation

This table presents Tobit and ordinary least squares (OLS) regressions of repurchases on employee stock-based compensation, control variables, and firm and year fixed effects. Panel A uses executive options outstanding and granted from Execucomp (for top five executives) over the period 1992 to 2016. Panel B uses total options outstanding, exercised and granted from Compustat during the period 2004 to 2016. Models 1, 2, and 3 report Tobit estimation and models 4, 5, and 6 report OLS estimates. All models include dummies for infrequent, moderate, and no repurchases and control for log(market capitalization), operating income, return on assets, market-to-book, capex, leverage, institutional ownership, log(age) and prior returns All independent variables are defined in the Appendix. Standard errors are clustered by firm. T-statistics are in parentheses and p-values are in brackets; ***, **, and * denote significance at 1%, 5%, and 10% respectively.

Panel A: Repurchases and executive stock options

	(1)	(2)	(3)	(4)	(5)	(6)
	Repurchase/lagged market capital					
	Tobit			OLS		
Exec options o/s * frequent	0.176***	0.066*	0.164***	0.165***	0.086**	0.156***
	(4.76)	(1.73)	(4.46)	(4.45)	(2.45)	(4.21)
Exec options o/s * moderate	0.158***	0.047	0.128***	0.129***	0.052*	0.117***
	(4.82)	(1.36)	(3.90)	(3.99)	(1.68)	(3.59)
Exec options o/s * infrequent	0.081***	-0.003	0.064**	0.053**	-0.003	0.049**
	(3.12)	(-0.11)	(2.47)	(2.29)	(-0.12)	(2.11)
Exec options o/s * no repurchases	-0.120***	-0.198***	-0.049	-0.009*	-0.048***	-0.005
	(-3.40)	(-4.63)	(-1.47)	(-1.70)	(-4.35)	(-0.85)
Exec options granted * frequent	0.629***	0.501***	0.678***	0.585***	0.479***	0.614***
	(5.26)	(4.37)	(5.70)	(4.88)	(4.20)	(5.12)
Exec options granted * moderate	0.410***	0.261**	0.453***	0.360***	0.255**	0.76***
	(3.58)	(2.26)	(3.92)	(3.16)	(2.32)	(3.28)
Exec options granted * infrequent	-0.043	-0.112	0.038	0.038***	-0.002	0.058***
	(-0.43)	(-0.93)	(0.39)	(3.01)	(-0.10)	(3.95)
Exec options granted * no repurchases	0.136	0.086	0.144	0.113	0.054	0.110
	(1.52)	(0.87)	(1.64)	(1.41)	(0.63)	(1.36)
F-tests with p-values						
Exec options o/s (freq-infreq)	0.095**	0.069**	0.100**	0.112***	0.089**	0.107**
P-value	[0.024]	[0.031]	[0.017]	[0.007]	[0.022]	[0.011]
Exec options granted (freq-infreq)	0.672***	0.613***	0.716***	0.623***	0.477***	0.556***
P-value	[0.001]	[0.002]	[0.003]	[0.001]	[0.002]	[0.001]
Number of observations	39,446	39,446	39,446	39,446	39,446	39,446
Fixed Effects	FF48/Year	Firm/Year	FF48-year	FF48/Year	Firm/Year	FF48-year
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Likelihood Ratio/Adjusted R²	36,323***	39,675***	37,437***	0.380	0.339	0.394

Panel B: Repurchases and total employee stock options

	(1)	(2)	(3)	(4)	(5)	(6)
	Repurchase/lagged market capital					
	Tobit			OLS		
Total options o/s *frequent	0.157***	0.172***	0.162***	0.147***	0.186***	0.150***
	(43.03)	(14.81)	(44.86)	(9.25)	(11.29)	(9.36)
Total options o/s * moderate	0.099***	0.111***	0.101***	0.090***	0.113***	0.092***
	(29.56)	(8.27)	(30.74)	(5.91)	(7.07)	(6.02)
Total options o/s * infrequent	0.081***	0.103***	0.079***	0.074***	0.106***	0.073***
	(35.31)	(7.90)	(34.92)	(5.43)	(6.87)	(5.40)
Total options o/s * no repurchases	0.004	0.013	0.005	0.007**	0.032***	0.007**
	(0.90)	(1.04)	(1.35)	(2.29)	(5.63)	(2.30)
Options exercised * frequent	0.252***	0.190***	0.229***	0.304***	0.214***	0.290***
	(16.62)	(4.59)	(15.18)	(5.69)	(4.18)	(5.40)
Options exercised * moderate	0.093***	0.075	0.080***	0.173***	0.121**	0.158***
	(6.71)	(1.46)	(5.81)	(3.06)	(2.21)	(2.81)
Options exercised. * infrequent	0.021	-0.068	0.022	0.029	-0.057	0.020
	(0.68)	(-1.30)	(0.56)	(0.60)	(-1.12)	(0.42)
Options exercised * no repurchases	-0.013	0.006	-0.012	-0.046***	-0.040***	-0.047***
	(-0.73)	(0.11)	(-0.64)	(-5.07)	(-3.01)	(-4.85)
Options granted * frequent	0.002	0.037	0.002	-0.009	0.067	-0.008
	(0.14)	(0.89)	(0.12)	(-0.15)	(1.10)	(-0.13)
Options granted * moderate	0.151**	0.124*	0.160*	0.126*	0.092*	0.130*
	(2.11)	(1.95)	(1.90)	(1.91)	(1.85)	(1.88)
Options granted * infrequent	-0.008	0.032	-0.009	-0.027	0.005	-0.026
	(-0.96)	(0.81)	(-0.98)	(-0.78)	(0.13)	(-0.75)
Options granted* no repurchases	-0.042***	-0.050	-0.032***	0.005	0.010	0.007
	(-3.52)	(-1.48)	(-2.74)	(0.89)	(1.23)	(1.33)
F-tests with p-values						
Total options o/s (freq-infreq)	0.076***	0.069***	0.083***	0.073***	0.080***	0.077***
P-value	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Options exercised. (freq-infreq)	0.231***	0.258***	0.207***	0.275***	0.271***	0.270***
P-value	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Options granted (freq-infreq)	0.010	0.005	0.011	-0.036	0.072	-0.018
P-value	[0.634]	[0.920]	[0.683]	[0.799]	[0.377]	[0.803]
Number of observations	37,324	37,324	37,324	37,324	37,324	37,324
Fixed Effects	FF 48/Year	Firm/Year	FF48-year	FF 48/Year	Firm/Year	FF48-year
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Likelihood Ratio/Adjusted R^2	26,092***	26,625***	26,367***	0.394	0.305	0.399

Online Appendix

OA1

Transition matrix for quarters of repurchases

This table compares the propensity of a firm to repurchase in a certain fiscal quarter in the current year, conditional on the fiscal quarter in which it repurchased last year. Panel A presents the results for infrequent repurchasers and Panel B for moderate repurchasers. Cell(i, j) presents the fraction of firms that repurchase in i_{th} fiscal quarter in $year_t$ and j_{th} fiscal quarter in $year_{t+1}$.

| | | $Year_{t+1}$ | | | |
		Q1	Q2	Q3	Q4
Panel A: Infrequent repurchasers					
$Year_t$	Q1	13.02%	6.74%	11.64%	13.02%
	Q2	1.01%	0.85%	0.73%	0.78%
	Q3	5.73%	3.44%	6.54%	6.06%
	Q4	7.13%	4.21%	7.59%	11.51%
Panel B: Moderate repurchasers					
$Year_t$	Q1	17.58%	9.21%	17.94%	19.92%
	Q2	4.86%	2.66%	4.15%	5.78%
	Q3	16.56%	8.78%	18.25%	18.10%
	Q4	14.80%	8.05%	15.94%	17.42%

OA2
Undervaluation index for frequent and infrequent repurchasers

This table examines the undervaluation index for frequent and infrequent repurchasers during the period 1990 to 2016. The Undervaluation index is the sum of the quintile ranks based on size (smallest: 5, largest: 1), past returns (lowest return: 5, highest return: 1), and book-to-market (Highest: 5, Lowest: 1). Repurchases by firms with U-index > 10 are more likely to be motivated by undervaluation, while those with U-index < 6 are less likely to be motivated by undervaluation. Numbers in the table denote the percentages of frequent/infrequent repurchasers with U-index > 10 or U-index < 6 across different periods.

	Undervaluation index < 6			Undervaluation index > 10		
	Frequent	Infrequent	T-stat of difference	Frequent	Infrequent	T-stat of difference
1990-1999	20.8%	11.7%	*12.9*	24.4%	33.4%	*10.5*
Number of observations	*1,087*	*684*		*1,277*	*1,946*	
2000-2009	25.3%	16.2%	*13.4*	18.0%	27.0%	*12.6*
Number of observations	*1,878*	*1,038*		*1,337*	*1,734*	
2010-2016	31.4%	17.0%	*16.6*	11.9%	22.4%	*13.0*
Number of observations	*1,941*	*610*		*736*	*803*	

OA3
Variation in option compensation with repurchase frequency

This table reports the options compensation for frequent, moderate, and infrequent repurchasers respectively. Panel A reports the results for total options outstanding, exercised and granted from Compustat during 2004 to 2016. Panel B uses executive options outstanding and granted from Execucomp (for top five executives) over 1992 to 2016. All option variables are reported as a percentage of shares outstanding. Please refer to the appendices for detailed variable definitions. Last column reports the differences between frequent and infrequent repurchasers; ***, **, and * denote significance at 1%, 5%, and 10% respectively.

Panel A: Total stock options from Compustat

	Frequent	Moderate	Infrequent	Frequent - Infrequent
Period		2004–2016		
Total Options Outstanding	6.75	6.72	6.57	0.18
Total options exercised	1.17	1.04	0.91	0.26***
Total options granted	0.96	1.1	1.2	-0.24***
Number of observations	8,816	4,736	4,799	

Panel B: Stock options for top five executives (from Execucomp)

	Frequent	Moderate	Infrequent	Frequent - Infrequent
Period		1992–2016		
Executive options outstanding	19.75	22.46	22.28	-2.53***
Executive options granted	3.42	4.05	4.26	-0.83***
Number of observations	10,630	5,878	5,764	

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