

The Persistence of Share Repurchases, Financing, and Firm Maturity

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Abstract

This study documents evidence that share repurchases have become persistent in recent years, as an increasing number of firms repurchase shares year after year. This persistence means that share repurchases are now a long-term cash flow commitment. Firms use cash flow as the primary source of capital to finance their repeated share repurchases. This internal financing has cumulatively large effects on capital structure in the form of steady increases in retained earnings and comparable decreases in paid-in-capital over time. Our findings suggest that the traditional understanding of share repurchases—as the distribution of transitory cash flow, a response to undervaluation or a means of raising the debt ratio—is probably outdated. We propose that share repurchases have become strongly associated with a firm’s financial life-cycle stage, as quantified by the retained earnings-to-assets ratio. Financially mature firms display a long-term increase (decline) in the sensitivities of their share repurchases (investments) to cash flow.

JEL classification: G31, G32, G35

Key words: Share repurchases, valuation, cash flow, retained earnings, capital structure, firm maturity

1. Introduction

Previous studies put forth numerous explanations concerning the nature and determinants of share repurchases. For example, the undervaluation hypothesis holds that firms perform share repurchases when their stocks are undervalued (Stephens and Weisbach, 1998; Dittmar, 2000; Bonaimé, Öztekin, and Warr, 2014). The temporary cash flow hypothesis and the excess cash hypothesis postulate that firms use share repurchases as a means of distributing temporary cash flows and excess cash, respectively (Dittmar, 2000; Guay and Harford, 2000; Jagannathan, Stephens, and Weisbach, 2000; Lee and Suh, 2011). Previous research also reports that share repurchases have supplanted dividends as the primary payout method for U.S. listed firms (e.g., Grullon and Michaely, 2002). Indeed, our own investigation shows that the percentage of share repurchasing firms in the Compustat non-financial and non-utility universe has increased from 0.2715 in 1980 to 0.4864 in 2017.

However, we point out that not only has the number of share repurchasing firms increased over time, but an increasing proportion of such firms have also repurchased shares in consecutive years. In short, share repurchases have become persistent. To demonstrate that share repurchases are increasingly performed in more consecutive years, we plot the means of dummy variables that reflect the extent of consecutive share repurchases over the period 1980-2017. In Figure 1, the mean of *REP_5YR_C*—a dummy equal to one if a firm repurchases shares consecutively every year for the next four years assuming that the firm repurchases shares in the current year—is about 30 percent in the early 1980s, but increases to over 65 percent in the 2010s. A similar pattern is found for the mean *REP_3YR_C*—a dummy equal to one if a firm repurchases shares consecutively every year for the next two years assuming that the firm repurchases shares in the current year.

The purpose of the present study is to explore the motives behind and the effects of share repurchases that are now highly persistent. This persistence means that share repurchases have become a long-term cash-flow commitment and therefore implies that share repurchases have substantial and lasting effects on the firm's investment and capital structure.

Our main sample of share repurchasing firms consists of 2,242 unique firms that announce share repurchase programs over the period 1994-2017. We identify those announcement firms using the SDC Platinum database. To ensure the robustness and generality of our findings, we also construct an auxiliary sample of share repurchasing firms that are identified based on cash flow-statement items from Compustat. Our examination of the main sample (i.e., the share-repurchase-announcement sample) shows that as many as 75.56 percent of those announcement firms repurchase shares every year in the following four years in

addition to the announcement year. Also, those announcement firms unload cumulatively large sums of cash in share repurchases after their announcements, as the mean (median) of the cumulative sum of share repurchases over the five-year period ($t, t+4$) is as large as 0.3125 (0.2157) of the beginning-of-period book assets.

To determine firm characteristics associated with share repurchases, we split the sample into two groups—top-half and bottom-half share repurchasing firms—based on the sum of share repurchases over five-years ($t, t+4$) scaled by the beginning-of-period book assets. We find that the top-half share repurchasing firms have higher Tobin's Q values than the bottom-half share repurchasing firms. Also, the top-half firms have higher stock return run-ups leading to the announcements than bottom-half firms. We also find that the top-half firms are more profitable than the bottom-half firms. Our Tobit regressions of the amount of share repurchases show that Tobin's Q and stock return run-up have a significant positive effect and an insignificant effect, respectively, on the amount of share repurchases. These findings suggest that share repurchase decisions are not driven by undervaluation or stock underperformance.

We then analyze the changes of capital structure components of the share repurchase announcement firms, measured over the five-year period ($t, t+4$). Among the candidate sources of capital for share repurchases, retained earnings change most substantially over the five-year period and this change is much greater for top-half firms than for bottom-half firms. This raises the possibility that internal funds are the key source of capital to finance share repurchases. In comparison, the amount of debt issuance and the change in cash reserves over the five-year period are relatively small.

Additional evidence suggests that internal funds are the primary source of capital to finance share repurchases. First, the amount of internal funds, as measured by cash flow, exceeds the amount of share repurchases in more than 80 percent of firm-years over the five-year window ($t, t+4$), suggesting that an absolute majority of firms can finance their share repurchases without turning to external funds. Second, firms vary the intensity of their share repurchase activity based on the availability of internal funds, as the amount of share repurchases is higher in years with above-the-mean cash flows than in years with below-the-mean cash flows. Third, regressions show that share repurchases are highly sensitive to cash flow. Particularly, share repurchases-cash flow sensitivities are even higher than investment-cash flow sensitivities for non-dividend-paying firms. These findings suggest that share repurchasing firms prioritize share repurchases almost as much as or even more than investments in allocating cash flow.

Our evidence of cumulatively large payouts from consecutive share repurchases raises concerns that share repurchases may divert too much capital away from investment, thereby causing underinvestment.

Following Biddle, Hillary, and Verdi (2009), we estimate a regression of investment on sales growth and use the residuals as a proxy for deviation from the expected investment. We find that share repurchase announcement firms (as well as the top-half firms among them) do not underinvest relative to the typical firm or matched rival firms. We also find that share repurchasing firms do not overinvest either relative to the typical firm or matched rival firms. This finding may suggest that share repurchases help curb excessive investments by distributing free cash flows to shareholders.

The increasing prevalence and persistence of share repurchases implies that a firm's ability to generate large and consistent cash flow is essential to finance share repurchases year after year. We hypothesize that firm maturity is systematically related to share repurchase under the premise that this ability increases with the financial life-cycle stage. Using the Compustat firms over the period 1994-2017, we establish that share repurchases are systematically associated with the retained earnings-to-assets ratio (RE), a proxy for firm maturity. High-RE firms (i.e., financially mature firms) are the most active share repurchasing firms in terms of both the propensity to repurchase shares and the amount of share repurchases. Also, high-RE firms repurchase share much more than they pay dividend, compared to the other subgroups of firms. Moreover, high-RE firms display gradual and cumulative large (mutually offsetting) changes in retained earnings and paid-in-capital in their capital structure. The last observation is consistent with the notion that internally-financed share repurchases cause simultaneous increases in retained earnings and decreases in paid-in-capital.

We also document that the sensitivities of investments and share repurchases to cash flow vary systematically with the financial life-cycle stage, as investment-cash flow sensitivities are negatively associated with financial maturity, whereas share repurchase-cash flow sensitivities are positively associated with such maturity. As a result, high-RE firms display the lowest investment-cash flow sensitivities but highest share repurchase-cash flow sensitivities. Therefore, a firm's financial life-cycle stage is a good descriptor of how well or the extent to which the firm's cash flow determines the intertemporal variation of investments and share repurchases. As firms mature financially, share repurchases take precedence over investments in the allocation of cash flow.

Finally, we examine the long-term trends of investment-cash flow and share repurchase-cash flow sensitivities using the Compustat firms over the 1980-2017 period. We confirm that investment-cash flow sensitivities display a secular decline (e.g., Chen and Chen 2012). We go further to show that the long-term decline in investment-cash flow sensitivities is most pronounced for high-RE firms, that is, financially mature firms. Moreover, share repurchase-cash flow sensitivities have increased over time for high-RE

firms as well as positive RE firms. Taken together, these observations suggest that the increasing prevalence and persistence of share repurchases have contributed to the weakening sensitivities of investments to cash flow, particularly, among financially mature firms.

Overall, our findings suggest that existing share repurchase hypotheses—specifically the temporary cash-flow hypothesis, the undervaluation or stock underperformance hypothesis, and the underleverage hypothesis—have lost explanatory power. First, the size of repeated share repurchases, particularly those by high-RE firms, is so large that it is unlikely that such repurchases could be funded by nonrecurring, one-time windfall profits. Additionally, our evidence shows that share repurchases are backed by the consistent generation of internal funds over a sustained period. Second, contrary to the undervaluation or stock underperformance hypothesis, share repurchases are positively associated with high firm valuation or with superior stock performance prior to share repurchase announcements. Third, it does not appear that firms repurchase shares with the intention of raising the leverage ratio, given that they finance much of their share repurchases with internal funds. Internally-financed share repurchases have a neutral effect on the leverage ratio, as the increases in retained earnings offset the decreases in paid-in-capital.

The evidence of increasingly large and persistent share repurchases calls for a new framework. We propose that share repurchases have become strongly associated with a firm's financial life-cycle stage, as quantified by the retained earnings-to-assets ratio. Indeed, our findings reshape the understanding of the relevance of firm maturity to payout policy. The retained earnings-to-assets ratio is the better descriptor of share repurchase activities in recent years than of dividends activities, particularly, because of the long-term trend in which high-RE firms (i.e., financially mature firms) have increased share repurchases but decreased dividends.

Our firm-maturity framework draws on DeAngelo, DeAngelo and Stulz's (2006) financial-life-cycle hypothesis, but our framework concerns share repurchases instead of dividends. Moreover, unlike dividends, share repurchases are systematically correlated to cash flow and this pattern is most pronounced for high-RE firms. Firms vary share repurchases over time based on the amount of cash flow each year to the point that their share repurchases weaken the responsiveness of investments to cash flow. Our framework can help explain not only major changes in U.S. firms' payout activities but also key long-term trends of their investment and capital structure. Indeed, our evidence suggests that the prevalence and persistence of share repurchases have wide, long-run effects in the form of decreasing investment-cash flow sensitivities and increasing retained earnings. These effects are most pronounced among financially mature

firms.

Our framework is also related to Lee, Shin and Stulz's (2020) finding that high-Q firms have repurchased shares more but invested less in recent years, as financial mature firms command high firm valuations despite their slow growth. Finally, our findings suggest that the residual-cash-flow model (e.g., Brav, Graham, Harvey and Michaely, 2005) may have lost explanatory power to some extent. Our evidence of increasingly high (low) share repurchase-cash flow sensitivities (investment-cash flow sensitivities) suggests that U.S. firms actively allocate cash flow to share repurchases away from investments.

The rest of the paper is organized as follows. Section 2 reviews previous research. Section 3 describes our data. Section 4 presents evidence that share repurchases have become persistent. Sections 5 and 6 perform main and additional empirical analyses, respectively. Section 7 concludes.

2. Review of existing studies on share repurchases

This section reviews the hypotheses and proxy variables put forth by extant U.S. studies regarding the motivations for share repurchases. As noted above, these studies report several reasons for corporate managers to distribute cash through share repurchases. For example, share repurchases provide corporate managers with flexibility in terms of timing and the amount of cash payouts (e.g., Grullon and Michaely, 2002). Along these lines, many researchers hypothesize that firms use share repurchases to pay out temporary cash flows (Dittmar, 2000; Guay and Harford, 2000; Jagannathan et al., 2000). These researchers use several different approaches in finding evidence for this temporary cash flow hypothesis. Guay and Harford (2000) estimate the transitory component from operating cash flows and find that it is positively related to the decision to repurchase shares. Jagannathan et al. (2000) and Dittmar (2000) use non-operating income as a proxy for temporary cash flows, and both find that non-operating income is positively related to share repurchases.

Some authors hypothesize that firms use share repurchases to distribute excess capital. This excess capital hypothesis relates to the free cash flow hypothesis of Jensen (1986) in that excess capital gives rise to agency costs of overinvestment unless it is distributed to shareholders. Dittmar (2000) uses cash holdings as a proxy for excess capital and finds that cash holdings are positively related to share repurchases. Lee and Suh (2011) examine the dataset of seven major countries' share repurchases and document evidence that firms tend to hold excess cash before their share repurchases, and that the source of their excess cash is the reduction in capital expenditures. Prior studies also propose the undervaluation (or signaling) hypothesis that firms use share repurchases to signal that their stocks are undervalued (Chan et al., 2004;

Comment and Jarrell, 1991; Dann, 1981; Vermaelen, 1981). These studies find that firms experience positive excess returns around announcements of share repurchases and argue that such finding is consistent with the undervaluation hypothesis. In a similar vein, Stephens and Weisbach (1998) and Dittmar (2000) provide evidence for the undervaluation hypothesis by showing that firms conduct share repurchases when their stocks are undervalued in terms of market-to-book ratios and lagged stock returns. However, Grullon and Michaely (2004) reject the cash-flow-signaling hypothesis by documenting that share repurchases are not associated with improvements in operating performance. Taken together, prior studies suggest that share repurchases may signal undervaluation but not necessarily improvement in operating performance.

As noted above, the list of hypotheses does not stop here. Prior U.S. studies also provide evidence that the presence of stock option programs influences firms' decisions about share repurchases (Fenn and Liang, 2001; Jolls, 1998; Jun et al., 2009; Kahle, 2002); that firms use share repurchases to beat analysts' earnings estimates (Hrbar, Jenkins, and Johnson, 2006; Gong, Louis, and Sun, 2008; Almeida, Fos, and Krolund, 2016); that firms use share repurchases to defend themselves against takeovers (Billett and Xue, 2007; Denis, 1990); and that some managers use share repurchases to mislead investors (Chan et al., 2010). Additionally, taxes may influence decisions to repurchase shares because, compared to dividends, share repurchases provide shareholders with tax benefits (Barclay and Smith, 1988; Black, 1976). Grullon and Michaely (2002) document that share repurchases become more frequent after tax reform in 1987 favors capital gains relative to dividend income. Hsieh and Wang (2008) document evidence that inside shareholders' tax preferences affect a firm's choice of payout method between dividends and share repurchases.

3. Data

Previous research uses two approaches to identifying share repurchasing firms or share repurchases. The first approach is based on share repurchase announcement records from the SDC database (e.g., Grullon and Michaely, 2004; Barger, Bonaimé, and Thomas, 2017). The second is based on the amount of share repurchases calculated as the purchase of common and preferred stock [PRSTKC] less any reduction in the preferred stock redemption value [PRTKRV] from the Compustat database. If this amount is positive, the firm is deemed as having repurchased shares in that year (e.g., Dittmar, 2000; Grullon and Michaely, 2002). We use both approaches to identify share repurchases.

Our main sample of share repurchasing firms is constructed using the first approach—using share repurchase announcement records collected from the SDC database—over the period 1994-2017. We define

a share repurchase announcement year as the year in which INIT_AUTHOR in the database is 1, which means that a share repurchase program is authorized in that year. After identifying a share repurchase announcement year, we turn to the Compustat database to ensure that the firm follows through with actual share repurchases. We filter out share repurchases announcement firms if these firms' actual share repurchases are zero in the announcement year and the following two years. We drop firms in the financial and utilities sectors and firm-years with negative book equity. We also drop firms if their key firm characteristics such as cash and cash flow are missing in any year over the period $(t-4, t+4)$ around the announcement year (t) . After this screen procedure, our main sample includes of 2,242 announcement-years consisting of 965 unique firms for the period 1994-2017.

Our auxiliary sample of share repurchasing firms is constructed based on the second approach using the amount of share repurchases from the Compustat database. If this amount is positive, we deem the firm as having repurchased shares in that year. We apply the same screening procedure as stated above for the construction of our main sample. Compared to the main sample, the auxiliary sample spans a longer period—1980-2017. As stated in Lee, Park, and Pearson (2015), the SDC database's coverage of share repurchase announcements is rather limited for the years prior to 1994. This limitation means that firms that repurchase shares may not be included as share repurchase announcement firms in the SDC in those early years. The second approach, which we use to construct our auxiliary sample, does not have this problem and thus allows us to analyze a longer period.

Appendix Table A.1 provides the definitions of the variables used in this study. To deal with extreme observations, we winsorize continuous variables at the bottom and top 1 percent of their respective distribution.

4. Prologue: an increasing trend of repeated share repurchases over the period 1980-2017

4.1. Proportions of firms that repurchase shares consecutively

In Table 1, the first column reports the percentage of share repurchasing firms in the Compustat non-financial and non-utility universe each year over the period 1980-2017. To demonstrate the extent to which firms repurchase shares consecutively, the other columns report the mean values of dummy variables ranging from REP_1YR_C to REP_5YR_C . REP_nYR_C is a dummy variable that equals 1 if a firm repurchases shares every year over the next $n-1$ years, and zero otherwise, conditional on the firm repurchasing shares in the current year. By definition, REP_1YR_C is 1. As an example, REP_5YR_C equals 1 if a firm repurchases shares consecutively every year for the next four years, provided the firm

repurchases shares in the current year. The mean of REP_nYR_C can be interpreted as the likelihood that a share repurchasing firm continues to repurchase shares in at least n years consecutively.

The first column of the table shows a long-term rise in the proportion of firms that repurchase shares. The percentage of share repurchasing firms is 0.2715 in 1980 and increases to 0.4864 in 2017, although this increase is not monotonic over time. More importantly, the rest of the table shows that the increasing proportions of share repurchasing firms continue to repurchase shares consecutively in subsequent years. For example, the mean of REP_2YR_C is 0.6048 in 1980, suggesting that 60.48 percent of share repurchasing firms in 1980 repurchase shares in the following year. Although this mean does not increase monotonically, there is an upward trend. The mean of REP_2YR_C in 2016 is as high as 0.8292, suggesting that 82.92 percent of share repurchasing firms in 2016 repurchases shares in the following year.

The means of the other variables, REP_3YR_C , REP_4YR_C and REP_5YR_C , display similar ascending trends. For example, the mean of REP_5YR_C is relatively modest (0.3071) in 1980 so 30.71 percent of share repurchasing firms in this year continue to repurchase shares consecutively in the following four years. This mean more than doubles to 0.6875 in 2013, suggesting that as many as 66.74 percent of share repurchasing firms in this year repurchase shares consecutively in the following four years.

These observations suggest that share repurchases have become persistent. Not only does the number or percentage of share repurchasing firms increase in the U.S. stock market, but an increasing proportion of share repurchasing firms also repurchase shares in consecutive years.

4.2. Logit regressions

In Table 2, we estimate logit regressions to further demonstrate that share repurchases have become persistent. The sample consists of firms in the Compustat non-financial and non-utility universe and spans the period 1980-2016.

The dependent variables in these logit regressions are a range of dummy variables ($REP1C_DUM$, $REP2C_DUM$, $REP3C_DUM$ and $REP4C_DUM$) that indicate the extent to which firms repurchase shares in consecutive years. $REPnC_DUM$ equals one if the firm repurchases shares consecutively for at least the next n years and zero otherwise. For example, $REP4C_DUM$ equals one if the firm repurchases shares consecutively for at least four subsequent years, and zero otherwise. A common explanatory variable in all regressions is REP_DUM , a dummy variable that indicates whether the firm repurchases shares in the current year. Another common variable is $Time$, an integer variable that takes the value 1 if the firm-year belongs to the first year of the sample, 2 if it belongs to the second year of the sample, and so on. In Columns

(2), (4), (6) and (8), we interact REP_DUM with $Time$.

In all Columns (1)-(8), REP_DUM has a significant positive coefficient, suggesting that firms that repurchase shares tend to repurchase shares in subsequent years. Also, in all columns, $Time$ has a positive significant coefficient, reflecting the fact that the proportions of share repurchasing firms and those that repurchase shares several years in a row have increased. Finally, in Columns (2), (4), (6) and (8), the interaction $REP_DUM \times Time$ has a significant positive coefficient, suggesting that the extent to which share repurchasing firms continue to repurchase shares in consecutive years has increased. These results provide corroborating evidence that share repurchases have become persistent.

5. Main analyses

5.1. The share repurchase continuity of the share repurchase announcement firms

In Table 3, we analyze the continuity and amount of share repurchases over the five-year window $(t, t+4)$ —where year t is the share-repurchase-announcement year—for our sample of share repurchase announcement firms constructed from the SDC Platinum database. We calculate the amount of share repurchases for each firm-year using the *Compustat* cash-flow-statement variables.

Panel A shows that a high fraction of share repurchase announcement firms repurchase shares consecutively. 87.60 percent of the announcement firms repurchase shares consecutively in years t and $t+1$, 75.47 percent of them do so in years $t, t+1$ and $t+2$, and so on. The last column indicates that as many as 61.11 percent of those announcement firms repurchase shares every year in five consecutive years. This continuity in the share repurchase announcement sample echoes the evidence of share repurchase persistence in the Compustat universe reported in Tables 1 and 2.

Panel A also shows that the cumulative sum of share repurchases increases with time. In the announcement year, the mean (median) amount of share repurchases scaled by the beginning-of-period book assets (denoted by REP_t/TA_{t-1}) is 0.0708 (0.0429). The mean (median) of the cumulative sum of share repurchases over the five-year period $(t, t+4)$ scaled by the beginning-of-period book assets (denoted by $\Sigma REP_{(t, t+4)}/TA_{t-1}$) is as large as 0.3116 (0.2188).

In Panels B and C, we split the share repurchase announcement sample into non-dividend payers and dividend payers, respectively. For both non-dividend payers and dividend payers, share repurchases are highly persistent. 57.41 percent of non-dividend payers repurchase shares consecutively for five years $(t, t+4)$ and 64.07 percent of dividend payers do so. The cumulative sum of share repurchases increases with time for both groups. Meanwhile, this cumulative sum is greater for non-dividend payers than for dividend

payers, as the mean (median) of five-year cumulative share repurchases (i.e., $\Sigma REP_{(t, t+4)}/TA_{t-1}$) is 0.3568 (0.2494) for non-dividend payers but 0.2753 (0.2010) for dividend payers.

5.2. Firm characteristics of the share repurchase announcement firms

In Table 4, we analyze an array of firm characteristics of the share repurchase announcement firms. The table reports the mean and median of those firm characteristics as measured at the beginning of the announcement years. We tabulate these mean and median for the full sample and also separately for firms that perform share repurchases in large amounts (which we term “top-half firms”) and those that do so in small amounts (which we term “bottom-half firms”). We rank the sample announcement firms into top-half and bottom-half firms based on the sum of share repurchases over the five-year window ($t, t+4$) ($\Sigma REP_{(t, t+4)}/TA_{t-1}$). This split can help us determine whether and how firm characteristics vary with the amount of share repurchases.

The top row of the table shows that the mean (median) of five-year total share repurchases ($\Sigma REP_{(t, t+4)}/TA_{t-1}$) is as large as 0.3116 (0.2188) for the full sample. However, this mean (median) is widely different between top-half and bottom-half share repurchasing firms, as the mean (median) is as high as 0.5253 (0.4418) for top-half firms, while it is only 0.0979 (0.0910) for bottom-half firms. Also, top-half firms tend to be large in firm size ($\log(TA_{t-1})$) compared to bottom-half firms.

Interestingly, Tobin’s Q is significantly higher for top-half share repurchasing firms than for bottom-half share repurchasing firms, as top-half firms’ mean (median) Q is 2.51 (2.15) compared to bottom-half firms’ 1.65 (1.42). Top-half firms have higher Tobin’s Q on the industry-adjusted basis as well. The table includes stock return run-up ($SRET_{t-1}$) as a proxy for stock underperformance. Both the mean and median of this variable are relatively high for top-half firms, as their mean (median) is 0.2332 (0.1477) compared to bottom-half firms’ 0.1928 (0.1014). A similar finding is obtained on the industry-adjusted basis. We also note that the mean (median) of $SRET_{t-1}$ is positive and large for the full sample (0.2130 (0.1298)) and this is so even on the industry-adjusted basis (0.0862 (0.0064)). Taken together, our findings on Tobin’s Q and stock price run-up cast doubt on the notion that share repurchases are motivated by undervaluation or stock underperformance. If anything, firms that make repurchases in large amounts have high stock valuation and superior stock performance leading up to their share repurchase announcements, compared to firms that make repurchases in small amounts.

On the other hand, sales and asset growth rates (measured from year $t-2$ to year $t-1$) of top-half firms are not higher than those of bottom-half firms. In fact, the mean (median) sales growth of top-half

firms (0.1266 (0.0900)) is slightly lower than the corresponding value for bottom-half firms (0.1335 (0.0961)), although the difference is not significant. Therefore, despite their high Tobin's Q, top-half firms do not record faster growth in the preceding years compared to bottom-half firms. Meanwhile, top-half firms have higher operating profitability than bottom-half firms, as the mean (median) ROA for top-half firms is 0.2101 (0.1984) compared to 0.1659 (0.1549) for bottom-half firms. Top-half firms also have higher retained earnings ratios, as their mean (median) retained earnings ratio (0.3379 (0.3824)) is higher than that for bottom-half firms (0.2983 (0.3011)). Top-half firms also have relatively large cash holdings, as their mean (median) cash ratio (0.2066 (0.1509)) is higher than that for bottom-half firms (0.1298 (0.0714)).¹ On the other hand, top-half firms use less debt than bottom-half firms, as the mean (median) debt ratio of top-half firms (0.1367 (0.1028)) is lower than that of the bottom-half firms (0.1917 (0.1724)).

In untabulated results, we construct the same table as Table 4 after splitting the full sample into non-dividend payers and dividend payers. The comparisons of top- and bottom-half repurchasing firms among both non-dividend payers and dividend payers yield similar findings to those in Table 4. Most importantly, in both groups, top-half repurchasing firms have higher mean and median Q than bottom-half repurchasing firms. Moreover, in both groups, top-half repurchasing firms have higher stock return run-up than bottom-half repurchasing firms. Therefore, large share repurchases are associated with higher stock valuation and superior stock performance, irrespective of whether share repurchasing firms also pay dividends.

5.3. Tobit regressions of share repurchases

We estimate Tobit regressions to identify the relations between firm characteristics and share repurchases. We focus on the effects of Tobin's Q and stock return run-up ($SRET_{t-1}$) on share repurchases. The negative effects of these variables would be consistent with the undervaluation and stock underperformance hypotheses, respectively.

In Table 5's Tobit regressions, the dependent variables are share repurchases in the announcement year in Panel A and five-year total share repurchases over $(t, t+4)$ in Panel B. Regressions are estimated for a sample that consists of the share-repurchase-announcement firms and non-share repurchasing firms in the

¹ The table also shows that unlike cash holdings (measured by the cash ratio), excess cash displays relatively little difference between top-half and bottom-half repurchasing firms. The mean difference in excess cash between the two groups, the size of the difference is only 0.0104. Moreover, the mean excess cash for the entire sample is only 0.0051 and the median is even negative. Taken together, excess cash does not appear to be a major driver of share repurchases.

non-financial and non-utility Compustat universe. Unlike previous studies that estimate regressions of share repurchases, we include *Time* as an explanatory variable in all regressions in order to account for the long-term trend in which a growing number of firms repurchase shares.²

In Panel A's Column (1), Tobin's Q is an explanatory variable with firm size ($\log(TA)$) as the sole control variable. In Columns (3), $SRET_{t-1}$ is added as an additional explanatory variable along with an array of firm characteristics as control variables as in previous studies (e.g., Dittmar, 2000; Lee and Suh, 2011). Tobin's Q enters significantly with positive coefficients in both Columns (1) and (3). The significant positive effect of Tobin's Q remains unchanged in regressions that control for industry fixed effects in Columns (4) and (6). Meanwhile the coefficient on $SRET_{t-1}$ is insignificant in Columns (2) and (3) and continues to be insignificant in Column (5) and (6). Panel B's Tobit regressions, where the five-year sum of share repurchases is the dependent variable, yield similar results. Tobin's Q and $SRET_{t-1}$ have significant positive coefficients and insignificant coefficients, respectively, in the regressions where they are included.

In summary, Tobit regression results do not suggest that firms perform share repurchases to respond to undervaluation or stock underperformance. Instead, the significant positive effects of Tobin's Q suggest that firms with high valuation or high growth potential tend to repurchase shares.

5.4. Five-year changes in firm attributes after share repurchases

In Table 6, we analyze the changes of firm characteristics of share-repurchase announcement firms, measured over the five-year period ($t, t+4$), where year t is the announcement year. As in Table 4, we compare these changes for top-half and bottom-half firms.

An observation that stands out from the table is that top-half share repurchasing firms exhibit higher asset and sales growth rates than bottom-half share repurchasing firms. The mean five-year asset growth and sales growth of top-half firms are 0.5814 and 0.4625, respectively, both of which are higher than the corresponding means of bottom-half firms (0.4521 and 0.3722, respectively). Meanwhile, the increase in physical assets of top-half firms is not large compared to bottom-half firms, as both the mean and median of $\Delta PPE_{(t-1, t+4)}/TA_{t-1}$ of top- and bottom-half firms are about the same.

The remainder of Table 6 examines variables with which we can determine the primary source of capital that funds share repurchases. We consider cash reserves, debt issuance, and retained earnings as candidate sources of capital. The table shows that the five-year change in cash reserves ($\Delta Cash_{(t-1, t+4)}/TA_t$

² We find (unreported) that omitting *Time* from the regressions makes little or almost no difference to our inferences on the effects of other explanatory variables on share repurchases.

) is positive in both mean and median for both top-half and bottom-half share repurchasing firms. This increase in cash suggests that cash is unlikely to be the major source of capital that funds share repurchases, although the size of the increase in cash is small relative to that of the increase in book assets ($\Delta TA_{(t-1, t+4)}/TA_{t-1}$). Also, debt increases over the five-year period, as the mean (median) of $\Delta Debt_{(t-1, t+4)}/TA_{t-1}$ is 0.1275 (0.0418) for the full sample. However, the increase in debt is much lower than the amount of share repurchases over the five-year period, as the mean (median) five-year share repurchase is as large as 0.3116 (0.2188). Thus, debt issuance is also unlikely to be the major capital source for share repurchases.

In contrast, retained earnings increase in large amounts over the five-year period, as the mean (median) $\Delta RE_{(t-1, t+4)}/TA_{t-1}$ is as high as 0.2207 (0.1940) for the full sample. The median of $\Delta RE_{(t-1, t+4)}/TA_{t-1}$ (0.1940) in particular is comparable in size to the median of the five-year sum of share repurchases (0.2188). Moreover, top-half firms' retained earnings increase much more than those of bottom-half firms, as the mean (median) $\Delta RE_{(t-1, t+4)}/TA_{t-1}$ of top-half firms (0.2926 (0.2735)) is more than double the mean (median) of bottom-half firms (0.1436 (0.1184)). This finding adds to the likelihood that retained earnings are the primary source of capital to fund share repurchases. Corroborating evidence can be obtained by analyzing cash flow—which is the source of retained earnings—over the five-year period. Share repurchasing firms generate large cash flow, as the mean (median) five-year cash flow, denoted by $\Sigma CF_{(t, t+4)}/TA_{t-1}$, is as large as 0.7009 (0.6442) for the full sample. Moreover, the mean (median) five-year cash flow of top-half firms (0.8630 (0.7927)) is much greater than that of bottom-half firms (0.5389 (0.4951)). These findings suggest that share repurchasing firms—particularly those that repurchase shares in large amounts—turn to internally generated firms as the major source of capital to finance share repurchases.

5.5. Change in capital structure over (t-4, t+4) for top-half share repurchasing firms

We seek further evidence that retained earnings are the primary source of capital for share repurchases. We posit that as firms finance share repurchases by retaining cash flows, they will experience substantial increases in the retained earnings-to-assets ratio.

In Table 6's Panel A, we restrict our attention to top-half share repurchasing firms and tabulate the mean and median of capital structure components (scaled by book assets) each year over (t-4, t+4), along with the cash ratio. We restrict our attention to top-half share repurchasing firms, because those firms will more vividly exhibit the effects that share repurchases have on capital structure with their large share repurchases. In Panels B and C, we tabulate the mean and median values separately top-half share repurchasing firms among non-dividend payers and those among dividend payers, respectively.

Indeed, Panel A shows that top-half firms' retained earnings-to-assets ratio (the retained earnings ratio, hereafter) increases in the announcement year and also steadily in subsequent years. The mean (median) retained earnings ratio gradually increases from 0.3507 (0.3886) in year $t-1$ to 0.4409 (0.4452) in year $t+4$. This rise in the retained earnings ratio is a continuation of the upward trend in the years preceding the share repurchase announcements, as the mean (median) retained earnings ratio gradually increases from 0.2557 (0.3280) in year $t-4$ to 0.3507 (0.3887) in year $t-1$. Top-half firms' considerable increases in the retained earnings ratio are accompanied by almost equally considerable decreases in the paid-in-capital ratio. Over the period ($t-4$, $t+4$), the mean (median) paid-in-capital ratio drops steadily from 0.3096 (0.2003) in year $t-4$ to 0.0737 (0.0329) in year $t+4$. Increases in the retained earnings ratio work to offset decreases in the paid-in-capital ratio, as the shareholders' equity ratio (SEQ/TA) decreases but not as much as either the retained earnings ratio or the paid-in-capital ratio moves. The mean (median) shareholders' equity ratio decreases from 0.5631 (0.5591) in year $t-4$ to 0.5181 (0.5113) in year $t+4$ —thus by only about 4 percentage points. Taken together, these patterns reinforce the notion that firms primarily use retained earnings to finance their share repurchases.

Panels B and C show that top-half share repurchasing firms among both non-dividend payers and dividend payers experience steady and cumulatively significant increases in the retained earnings ratio. However, the size of the increase is much greater for non-dividend payers, as these firms' mean (median) retained earnings ratio increases from 0.0807 (0.2034) in year $t-4$ to 0.3721 (0.4072) in year $t+4$, i.e., by as much as about 29 (20) percentage points. These firms experience correspondingly large decreases in the paid-in-capital ratio, as the mean (median) paid-in-capital ratio drops from 0.5352 (0.3538) to 0.2115 (0.1505), i.e., by as much as about 32 (20) percentage points. For dividend payers, the increase in the retained earnings ratio is relatively modest, as its mean (median) increases from 0.4225 (0.4350) in year $t-4$ to 0.5126 (0.4790) in year $t+4$, i.e., by about 9 (4.5) percentage points. Correspondingly, the drop in these firms' paid-in-capital ratio is relatively modest as well, as its mean (median) decreases from 0.1029 (0.0792) in year $t-4$ to -0.0609 (-0.0017) in year $t+4$, i.e., by about 16 (8) percentage points.³

Turning our attention to the cash ratio, the mean (median) cash ratio decreases only slightly with share repurchases. For example, in Panel A, this mean (median) decreases from 0.2066 (0.1509) in year $t-1$ to 0.1874 (0.1410) in year $t+4$. The change in this mean (median) is also small from year $t-4$ to $t-1$. The

³ Unlike non-dividend paying share repurchasing firms, dividend-paying repurchasing firms' increase in their retained earnings ratios is smaller in size than their decrease in their paid-in-capital ratios. This difference in size could be because, unlike non-dividend paying firms, these firms' dividend payouts—which reduce retained earnings—prevent retained earnings from growing quickly.

relatively small change in the cash ratio has two implications. First, cash reserves are unlikely to be the major source of capital to financing share repurchases. Second, share repurchasing firms save little of retained earnings in cash reserves despite the fact that their retained earnings increase significantly.

In short, among the capital structure components, the retained earnings ratio displays the most significant change, accompanied by the corresponding large change in the paid-in-capital ratio. These findings provide further evidence that firms use retained earnings as their primary means of financing share repurchases.

5.6. Allocation of share repurchases over the five-year window ($t, t+4$)

Table 8's Panel A illustrates how the announcement firms vary their share repurchase activity annually over the five-year window ($t, t+4$). It shows that these firms repurchase shares in relatively large amounts in the announcement year (i.e., year 0), as the announcement year's share of the total five-year share repurchases is as much as 31.01% in mean. The year right after the announcement (i.e., $t+1$) also sees relatively large share repurchases, as its mean share is 20.57%. However, share repurchase activities of the last three years (i.e., years $t+2, t+3$ and $t+4$) do not taper off but remain robust, as their shares of the total five-year share repurchases exceed 15 percent in means. The bottom of Panel A reports the percentages of firm-years in which cash flow exceeds the amount of share repurchases or total payouts (i.e., the sum of share repurchases and dividends). These percentages are greater than or close to 80 percent across years; hence it is not common that firms repurchase shares by more than the amount of internal fund available.

In Panels B and C, we ask whether firms repurchase shares more (less) when internal funds, measured by cash flow, are large (small). For each announcement firm, we divide firm-years over ($t, t+4$) in Panel B (or ($t+1, t+4$) in Panel C) into two groups depending on whether the year's cash flow is above or below the period-mean or the period-median. We then compare the level of share repurchase activity of the two groups of years.

Indeed, Panels B and C shows that share repurchases are more active in above-the-mean (or median) cash-flow years than in below-the-mean (or median) cash-flow years. For example, in Panel B, the mean of share repurchases ($REP_i/TA_{i,t}$) in the above-the-mean cash flows years (0.0720) is higher than the corresponding mean in below-the-mean cash-years (0.0539). A similar pattern holds in Panel C where we repeat the same analysis over the window ($t+1, t+4$) instead of the window ($t, t+4$).

An additional observation worthy of note concerns how much of cash flow firms retain after distribution in the form of share repurchases and dividends. Both Panels B and C show that firms' retention

of cash flow after repurchasing shares and/or dividends is high in high-cash-flow years compared to low-cash-flow years. For example, in Panel B, the mean of pure retention, denoted by $CF_{t+i}-REP_{t+i}-DIV_{t+i}/TA_{t,i}$, is 0.0853 in the above-the-mean cash-flow years, compared to 0.0307 in the below-the-mean cash-flow years. Therefore, both share repurchases and the retention of cash flow tend to be high (low) when cash flow is high (low).

5.7. Sensitivities of investments and share repurchases to cash flow

The preceding analyses reveal that share repurchasing firms distribute considerable amounts of cash via share repurchases out of internal funds in the announcement year as well as subsequent years. This leads us to question whether firms prioritize share repurchases over investment in allocating cash flow or, put differently, how much share repurchases and investment are substitutes to each other

In Table 9, we estimate regressions of investment and share repurchases on cash flow in order to compare the extent to which investment and share repurchases are sensitive to the availability to internal funds.⁴ We include firm-years that belong to the five-year window $(t, t+4)$ in the regressions that control for Tobin's Q along with year and firm fixed-effects.

In Panel A, the estimated results suggest that share repurchases are highly sensitive to cash flow for the entire sample, as the coefficient on cash flow in the regression of share repurchases (denoted as share repurchase-cash flow sensitivity) in Column (2) is quite high (0.245). However, this coefficient is not as high as the corresponding coefficient in the regression of investments (denoted as investment-cash flow sensitivity) in Column (1) (0.340). On the other hand, unlike share repurchases, dividends are not so sensitive to cash flow, as the coefficient on cash flow in the regression of dividends is only 0.059 in Column (3).

In Columns (4)-(7), we estimate two sets of regressions, one exclusively for non-dividend-paying firms and the other exclusively for dividend-paying firms in our sample. Columns (4) and (5) show that the estimated share repurchase-cash flow sensitivity (0.242) is almost identical to the estimated investment-cash flow sensitivity (0.243) for non-dividend-paying firms. However, in Columns (6) and (7), the investment-cash flow sensitivity (0.536) exceeds that on the share repurchase-cash flow sensitivity (0.251) by a wide margin for dividend-paying firms. Taken together, cash flow plays as great a role in financing share repurchases as in financing investment for non-dividend-paying firms, whereas this is not the case for

⁴ We do not interpret investment-cash flow sensitivities as a proxy for financing constraints. As Chen and Chen (2012) demonstrates, there is little evidence that these sensitivities reflect financial constraints.

dividend-paying firms. Also important is the observation that share repurchase-cash flow sensitivities are positive with similar magnitude for both non-dividend-payers and dividend-payers (0.242 and 0.251, respectively). This suggests that internal funds are an important source of share repurchases irrespective of whether the firm pays dividends or not.

In Table 9's Panel B, we estimate investment regressions by introducing a dummy variable that equals 1 (0) for the firm-year in which the amount of share repurchases is above (below or equal to) the period-mean over the five-year window (0, +4). We also interact investments with this dummy variable in Columns (2), (4) and (6). This large-share-repurchase dummy has consistently positive and significant coefficients in all regressions in Columns (1)-(6). Also, the interaction of cash flow with the large-share-repurchase dummy has negative coefficients, although it is not significant in Column (4) for non-dividend-firms. Taken together, these findings suggest that large share repurchases are associated with lower investments and also with lower investment-cash flow sensitivities.

In summary, although share repurchases are not as sensitive to cash flow as investments are (except for non-dividend-paying firms), share repurchases are highly sensitive to cash flow unlike dividends. There is evidence that large share repurchases reduce the level of investments as well as investment-cash flow sensitivities.

5.8. Underinvestment and overinvestment of share repurchasing firms

Our findings suggest that share repurchasing firms distribute substantial amounts of cash to shareholders with their consecutive share repurchases. Their large cash distributions raise concern that share repurchases may displace investment. A related notion is that share repurchases reflect poor management or, more specifically, managers' inability to identify and develop growth opportunities. In our next analysis, we seek to determine whether share repurchases (particularly large share repurchases) are associated with underinvestment.

Our method of estimating underinvestment is drawn from Biddle, Hillary, and Verdi (2009), who estimate a regression of investment on growth opportunities (as measured by sales growth) and then use the residuals as a firm-specific proxy for deviation from expected investment. The regression model is as follows:

$$Invest_{i,t} = \alpha_0 + \alpha_1 Sales\ Growth_{i,t-1} + \varepsilon_{i,t}, \quad (1)$$

where $Invest_{i,t}$ is total investment of firm i in year t scaled by book assets in year $t-1$, and $Sales\ Growth_{i,t-1}$ is the percentage change in sales from year $t-2$ to $t-1$. Equation (1) is estimated for each industry-year in the Compustat universe over the period 1994-2016 as long as the industry-year includes at least 20 observations based on the Fama and French 48-industry classification. We then rank firms based on the magnitude of the residuals into quartiles to create three groups. Firm-years in the bottom quartile (i.e., the most negative residuals) are classified as underinvestment, those in the middle two quartiles as normal investment, and those in the top quartile (i.e., the most positive residuals) as overinvestment.

In an alternative estimation approach in Equation (2), we consider the five-year sum of total investment over $(t, t+4)$ as the dependent variable—in place of $Invest_{i,t}$ in Equation (1)—before creating three groups based on the residuals. The regression model is as follows:

$$\sum Invest_{i,(t,t+4)} = \beta_0 + \beta_1 Sales\ Growth_{i,t-1} + \varepsilon_{i,(t,t+4)}, \quad (2)$$

Panel A of Table 10 reports the relative frequency (i.e., the likelihood) of underinvestment, normal investment, and overinvestment for all share-repurchase announcement firms (All), as well as top-half firms (High REP) and bottom-half firms (Low REP), respectively. As before, top-half and bottom-half firms are identified based on the sum of five-year share repurchases over the period $(t, t+4)$. In the left and right columns of the panel, underinvestment, normal investment, and overinvestment are determined based on the residuals from the regressions of one-year investment (Equation (1)) and five-year investment (Equation (2)), respectively.

The results do not suggest that share repurchasing firms underinvest or overinvest. To aid the reader in making inferences, we note that the likelihood of underinvestment or overinvestment should equal 25 percent and that of normal investment should equal 50 percent for a randomly selected firm. In comparison, the estimated likelihoods of underinvestment and overinvestment for all share repurchase announcement firms are lower (20.7% and 17.8%, respectively) than the 25 percent benchmark level, as reported in the left columns of the panel. We therefore conclude that share repurchasing firms are less likely to underinvest or overinvest than a typical firm. Consequently, the likelihood of normal investment for the share repurchasing firms is as high as 61.5%, which is much higher than the 50 percent benchmark level. Panel A also shows that top-half firms have a slightly lower likelihood of underinvestment (18.4%) than bottom-half firms (23.0%). Moreover, top-half firms have a much higher likelihood of overinvestment

(19.7%) than bottom-half firms (15.9%), which is consistent with our earlier finding that top-half firms grow faster than bottom-half firms.

In the right columns of Panel A, where the likelihoods of underinvestment and overinvestment are determined based on five-year investments, similar findings emerge. Share repurchasing firms do not underinvest or overinvest relative to the typical firm, as their likelihoods of both underinvestment and overinvestment (19.4% and 16.7%, respectively) are well below the 25 percent benchmark level. Also, top-half firms have a lower likelihood of underinvestment (18.3%) but a higher likelihood of overinvestment (19.3%) than bottom-half firms, whose likelihoods of underinvestment and overinvestment are 20.5% and 14.1%, respectively.

For comparison, Panels B and C tabulate the likelihoods of underinvestment, normal investment, and overinvestment of the samples of matched firms selected from non-share repurchasing firms. Matching is performed based on year and size in Panel B and year, industry, and size in Panel C, respectively. In both panels, the likelihood of normal investment is close to 50%, unlike in share repurchasing firms (as reported in Panel A). Also, the likelihood of underinvestment is high for these matched firms compared to share repurchasing firms. This finding is particularly true for the year-industry-and-size matched sample in Panel C, as the likelihood of underinvestment is 30.2% for one-year investment and 29.5% for five-year investment. These percentages are much higher than the likelihood of underinvestment for share repurchasing firms in Panel A. Therefore, share repurchasing firms are much less likely to underinvest than size-matched industry peers.

In short, share repurchases (even large share repurchases) are not associated with underinvestment. In fact, share repurchasing firms are much less likely to underinvest than a typical firm or a matched industry peer. Share repurchasing firms do not overinvest either, as their likelihood of overinvestment is much lower than that of the typical firm.

5.7. Firm characteristics of non-share repurchasing firms

In several of our analyses above, we compare firms that repurchase shares in large amounts (i.e., top-half share repurchasing firms) with those that repurchase shares in small amounts (i.e., bottom-half share repurchasing firms) as a means of identifying distinguishing characteristics of share repurchases. This approach may appear unusual, as it does not compare share repurchasing firms with non-share repurchasing firms. Behind our employment of this approach is the observation that a high percentage of firms repurchase shares intermittently even if they do not repurchase shares consecutively. This observation implies that if

we define the benchmark group as those firms that never repurchase shares over a sustained period, then the benchmark group will include only a small number of firms that have rather unique firm characteristics.

In Appendix Table A.2, Panel A shows that the number of firms decreases to only 590 out of a total of 2,783 firms in 2010 if we define the benchmark group as those firms that do not repurchase shares in any year over the nine-year period ($t-4, t+4$). This group has the following firm characteristics: high Tobin's Q, small firm size, poor profitability, negative retained earnings and large increases in paid-in-capital. These are typical firm characteristics that previous research attaches to frequent equity issuers (e.g., DeAngelo, DeAngelo and Stulz, 2010). Panels B and C yield similar interpretations for the years 2005 and 2000, respectively. In a nutshell, share repurchases are so commonplace in recent years—as the majority of firms repurchase shares consecutively or intermittently—that firms that never repurchase shares are few in number and a special variety (e.g., young, unprofitable, and potentially overvalued). Comparing share repurchasing firms with those non-share repurchasing firms is almost equivalent to comparing share repurchasing firms with frequent equity issuers. In other words, a comparison of share repurchasing firms and non-share repurchasing firms is unlikely to give us useful insights into the forces that shape share repurchases.

6. Further analyses using the Compustat universe

6.1. Tobit regressions for the periods before and after 1994

Previous studies report that firm value, as measured by Tobin's Q or the market-to-book ratio, has a negative impact on share repurchases, which is consistent with the undervaluation hypothesis (e.g., Dittmar (2000)). Therefore, our finding of Tobin's Q's positive impact on share repurchases must be reconciled with those earlier findings. We estimate Tobit regressions of share repurchases separately for two periods: the period 1980-1993 and the period 1994-2017. We conjecture that our finding of a positive effect of Tobin's Q arises partly because our main sample spans relatively recent years in which share repurchases are performed more consecutively, and also partly because our main measure of share repurchase is the five-year sum of share repurchases instead of share repurchases in each individual year.

In Table 11, we estimate Tobit regressions separately for the period 1980-1993 and the period 1994-2017. The estimation is performed on the non-financial and non-utility firms in the Compustat universe.⁵ In Panel A, where the dependent variable is the present year's share repurchases (REP_t/TA_{t-1}),

⁵ In Table 11's estimations, we do not use the SDC share repurchase announcement firms to identify share repurchasing firms, given the concern that the SDC database covers only a limited number of share repurchasing firms in early years.

Tobin's Q has either an insignificant coefficient (in Column (1)) or a significant negative coefficient (in Column (3)), when regressions are estimated for the period 1980-1993. The finding in Column (3) lends support to previous studies' findings that undervaluation is a key motive for share repurchases (e.g., Dittmar (2000)). However, Tobin's Q's coefficient turns significant positive in Columns (4) and (6), where regressions are estimated for the period after 1994-2017. This result corroborates our earlier finding in Table 5 in which Tobin's Q has a significant positive impact on share repurchases in the sample of share-repurchase announcement firms over the same period. Meanwhile, $SRET_{t-1}$ has positive coefficients in the columns where it is included as an explanatory variable, so the stock underperformance hypothesis probably does not hold even in the early years as well as in the recent years.

The results also show that firm size and firm size ($\log(TA_{t-1})$) and profitability (ROA_{t-1}) have positive coefficients in both the former and latter periods. However, the coefficients on both firm characteristics are significantly more positive in the latter period than those in the former period, as the comparison of the coefficients of the two periods shows. This suggests that the tendency for large and profitable firms to repurchase shares in large amounts have increased over time.

In Panel B, where the dependent variable is the five-year sum of share repurchases ($\sum REP_{(t,t+4)}/TA_{t-1}$), the results are qualitatively similar to those in Panel A. The impact of Tobin's Q on share repurchases is significantly greater for the latter period than it is for the former period, as the comparison of the coefficients on Tobin's Q indicates in the last columns. Moreover, the impacts of both firm size ($\log(TA_{t-1})$) and profitability (ROA_{t-1}) coefficients are greater for the latter period than they are for the former period. Therefore, compared to the early years, share repurchases are more tightly associated with high firm values, large firm size and high profitability in recent years.⁶

Summing up, there is some evidence that undervaluation used to be a motivation for share repurchases, but such is no longer the case in recent years. Overall, our results suggest that the motivation of share repurchases has shifted over time, potentially reflecting the pattern that share repurchases are now performed in more consecutive years. Compared to early years, share repurchases are associated more strongly with high valuation, large firm size and high profitability in recent years.

6.2. Share repurchase activities of subgroups by the financial life-cycle stage

The increasing prevalence and persistence of share repurchases implies that a firm's ability to

⁶ Interestingly, unlike in Panel A, the coefficients on Tobin's Q are significant positive in Panel B for the period 1980-1993. This finding could imply that cumulatively large share repurchases are positively associated with high firm value even in the early years.

generate steady and consistent cash flow is essential to finance share repurchases year after year. This idea suggests that firm maturity is systematically related to share repurchase under the premise that this ability increases with the financial-life cycle stage. DeAngelo et al. (2006) propose that dividend policy is systematically associated with the financial life-cycle stage as quantified by the retained-to-earnings ratio. We draw on their theory to explore whether and how firm maturity is associated with share repurchase activity.

In Table 12, we employ the retained earnings-to-assets (RE) as a proxy for firm maturity and partition firms into four subgroups: negative-RE firms, low-RE firms, medium-RE firms and high RE firms for the Compustat non-financial and non-utility firms. Panel A reports the mean and median of selected firm characteristics for each subgroup for the period 1994-2017. The high-RE firms (i.e., financially mature firms) are the most active share repurchasing firms in terms of both the propensity to repurchase shares and the amount of share repurchases. Also, the high-RE firms repurchase share much more than they pay dividend, compared to the other subgroups of firms. For example, the mean (median) of their five-year total share repurchases is 0.2250 (0.1211), compared with the mean (median) of the five-year total dividends, 0.1323 (0.0844). On the other hand, the high-RE firms grow slowly, as these firms' mean and median one-year sales growth rates are lower than those of all the other subgroups. However, the high-RE firms do not appear to underinvest, as their probability of underinvestment is lower than a couple of other subgroups.

In comparison, Panel B reports the mean and median of the same set of firm characteristics for the period 1980-1993. During this earlier period, the high-RE firms repurchase less than they pay dividends, as their five-year total share repurchases are lower than their five-year total dividends in both mean and median.

Figure 2 compares the mean values of five-year share repurchases and dividends for the four subgroups of firms sorted on the retained earnings-to-assets ratio for the period 1994-2017 (in Panel A) and the period 1980-1993 (in Panel B). The two graphs clearly illustrate that share repurchases varies with the financial-life cycle stage more systematically in the latter period than in the earlier period. Particularly, high-RE firms repurchase shares in much larger amounts than they pay dividends in the latter period. Further, Figure 3 shows that high-RE firms distribute a relatively high fraction of cash flow via share repurchases along with dividends, compared to other firms.

In the preceding sections, we demonstrated that the internal financing of share repurchases shapes capital structure in the form of simultaneous decreases in paid-in-capital and increases in retained earnings in the SDC share-repurchase-announcement sample. We predict that financially mature firms, that is, the

high-RE firms, experience substantial increases in retained earnings and decreases in paid-in-capital over time, as these firms are the most active in share repurchases.

Figure 4 depicts the trends of three capital-structure components for the high-RE firms for the period spanning 1996-2015. Indeed, the graph shows that the high-RE firms experience gradual and cumulatively large increases (decreases) in the mean retained-earnings ratio (the mean paid-in-capital ratio). On the other hand, the shareholders' equity ratio does not display either an upward or downward trend. These findings support the view that financially mature firms rely primarily on cash flow in financing their share repurchases year after year, which cause their retained earnings and paid-in-capital to increase and decrease, respectively, over time.

In summary, the main takeaway is that share repurchases are closely linked to the firms' financial life-cycle stage. Financially mature firms—i.e., those that generate large consistent cash flow—are the most active in share repurchases that are increasingly persistent. Moreover, financially mature firms experience gradual and cumulative large (offsetting) changes in retained earnings and paid-in-capital in their capital structure as a result of consecutive and large share repurchases.

6.3. Investment-CF and share repurchase-CF sensitivities for subgroups by firm maturity

We estimate regressions of investment and share repurchases on cash flow in order to determine whether and how the sensitivities of investments and share repurchases to cash flow vary with the financial life-cycle stage.

In Table 13, the results in Panels A and B suggest that investment-cash flow sensitivities are negatively associated with financial maturity, whereas share repurchase-cash flow sensitivities are positively associated with firm maturity. In Panel A, the coefficient on cash flow in the regressions of investments (i.e., investment-cash flow sensitivities) decreases monotonically from the low-RE firms (0.342) to the medium-RE firms (0.243) to the high-RE firms (0.102). This is consistent with the view that mature firms allocate less of its cash flows to investments than early-stage firms. The coefficient on cash flow for the negative-RE firms is negative (-0.036), however, probably because many of these firms suffer negative cash flow and turn heavily to equity financing. In Panel B, the coefficient on cash flow in the regressions of share repurchases (i.e., share repurchase-cash flow sensitivities) increases monotonically from the negative-RE firms (0.027) to the low-RE firms (0.031) to the medium-RE firms (0.043) to the high-RE firms (0.065).

In comparison, Panel C shows that dividend-cash flow sensitivities are generally smaller than

those of share repurchases. Across all RE-sorted subgroups, the size of the coefficients on cash flow in the regressions of dividends (i.e., dividend-cash flow sensitivities) is much lower than the size of the corresponding coefficients in Panel B's regressions on share repurchases. Moreover, unlike share repurchase-cash flow sensitivities in Panel B, dividend-cash flow sensitivities do not increase with financial maturity. This suggests that mature firms do not prioritize dividends in allocating cash flow as much as they do share repurchases.

In a nutshell, a firm's financial life-cycle stage is a good descriptor of how well or the extent to which the firm's cash flow determines the intertemporal variation of investments and share repurchases. Our regression results suggest that as firms mature, share repurchases take precedence over investments in the allocation of cash flow. Also, share repurchases are distinct from dividends, as firms—particularly, mature firms—allocate cash flow actively to finance share repurchases unlike dividends.

6.4. Long-term trends of investment-CF and share repurchase-CF sensitivities

The next set of regressions test whether the sensitivities of investments and share repurchases to cash flow display a long-term trend using Compustat firms over the 1980-2017 period. It is well documented that investment-cash flow sensitivities of U.S. firms have declined over time (e.g., Chen and Chen 2012).

In Table 14's Panel A, we confirm that investment-cash flow sensitivities display a secular decline. The coefficient on the interaction of cash flow with *Time* is negative in all three regressions of investment. The size of this coefficient is particularly more negative in the regression estimated separately for high-RE firms (-0.029), suggesting that the long-term decline in investment-cash flow sensitivities is more pronounced for financially mature firms. In contrast, there is also evidence that share repurchase-cash flow sensitivities have increased over time for firms with non-negative retained earnings as well as those with high retained earnings. In Columns (2) and (3), the coefficients on the interaction of cash flow with *Time* are significantly positive (0.002 and 0.002, respectively). In comparison, the last three columns of Panel A show that dividend-cash flow sensitivities have not increased over time. Rather, the negative coefficient on the interaction of cash flow with *Time* in Column (1) suggests that dividend-cash flow sensitivities have declined over time, unlike share repurchase-cash flow sensitivities.

In Panel B, we estimate the three sensitivities for each selected 10-year period. The results are reassuring. share repurchase-cash flow sensitivities display an upward trend for non-negative or high-RE firms, whereas investment-cash flow sensitivities exhibit a downward trend for those firms.

In short, the secular decline in investment-cash flow sensitivities of U.S. firms has been accompanied by the long-term increase in share repurchase-cash flow sensitivities. This observation raises the possibility that the increasing prevalence and persistence of share repurchases have contributed to the weakening sensitivities of investments to cash flow, particularly, among financially-mature firms.

7. Concluding remarks

This study has documented that share repurchases have become persistent, as an increasing number of firms repurchase shares year after year, probably based on multi-year programs that tend to be renewed when they expire (e.g., Bonaimé, Harford and Moore, 2020). Firms use cash flows as the primary source of capital to finance share repurchases year after year. This internal financing has cumulatively large effects on capital structure, as share repurchasing firms experience large, steady increases in retained earnings and comparable decreases in paid-in-capital over time.

Overall, our findings suggest that existing share repurchase hypotheses—specifically the temporary cash-flow hypothesis, the undervaluation or stock underperformance hypothesis, and the underleverage hypothesis—have lost explanatory power. The evidence of increasingly large and persistent share repurchases calls for a new framework. We propose that share repurchases have become strongly associated with a firm’s financial life-cycle stage, as quantified by the retained earnings-to-assets ratio. Our firm-maturity (or financial-life-cycle) framework draws on DeAngelo et al.’s (2006), but our framework is concerned with share repurchases instead of dividends. Moreover, we document that not only do financially mature firms distribute more cash with share repurchases, but also vary their share repurchases over time based on the amount of cash flow each year to the point that share repurchases weaken the responsiveness of their investments to cash flow. The framework can also help explain key long-term trends of their investments and capital structure components. The prevalence and persistence of share repurchases have wide, long-term effects on firms’ investments and capital structures in the form of decreasing (increasing) investment-cash flow (share repurchase-cash flow) sensitivities and decreasing (increasing) paid-in-capital (retained earnings). These effects are most pronounced among financially mature firms as a result of their internal financing of share repurchases.

Table A.1**Description of variables**

The mnemonics in square brackets correspond to *Compustat* data items.

Share repurchase (<i>REP</i>)	The amount of share repurchases, defined as the purchase of common and preferred stock [PRSTKC] less any reduction in the preferred stock redemption value [PRTKRV]
Dividend (<i>DIV</i>)	Dividends [DVC]
Total payout (TotalPay)	(Dividend + Share repurchases)
Tobin's Q (<i>Q</i>)	market value of total assets [AT + CSHO × PRCC_F – CEQ – TXDB] / book assets [AT]
Industry-adjusted Tobin's Q (<i>Ind. adj. Q</i>)	Q less mean industry Q at the SIC two-digit level
Stock returns (<i>SRET</i>)	1-year holding period return using monthly stock returns with a minimum of 6 months during the previous year from CRSP database
Industry-adjusted stock returns	<i>SRET</i> less mean industry <i>SRET</i> at the SIC two-digit level
Paid-in-capital to assets ratio	Paid-in-capital [CSTK + CAPS – TSTK] / book assets [AT]
Retained earnings to assets ratio (<i>RE/TA</i>)	Retained earnings [RE] / book assets [AT]
Shareholders' equity to assets ratio (<i>SEQ/TA</i>)	Shareholders' equity [SEQ] / book assets [AT]
Debt-to-asset ratio (<i>Debt/TA</i>)	Total debts [DLTT + DLC] / book assets [AT]
Firm Size (<i>Log(TA)</i>)	Natural log of book assets [AT]
Operating profitability (<i>ROA</i>)	Earnings before interest and taxes [OIBDP] / beginning-of-the-year total assets [AT] during the previous year
Cash holdings (<i>CASH</i>)	Cash and short-term investments [CHE] / book assets [AT]
Excess cash	Actual cash ratio minus predicted cash ratio, where predicted cash ratio is estimated using Bates et al.'s (2009) regression model. Specifically, predicted cash ratio is equal to $0.4804 + 0.4565 \cdot \text{industry cash flow volatility} + 0.0185 \cdot \text{Market-to-book} + (-0.0100) \cdot \log \text{TA} + (-0.0175) \cdot \text{cash flow/TA}$.
Stock return volatility (<i>RETVOL</i>)	The standard deviation of monthly stock returns for a given year
Asset growth (<i>Asset Growth</i>)	One-year growth rate of book assets [AT] from the previous year
Sales growth (<i>Sales Growth</i>)	One-year growth rate of sales [SALE]
Cash flow (<i>CF</i>)	Cash flow as defined as [IB] + [DP]
Investment (<i>Invest</i>)	Total investment, as measured by the sum of capital expenditures, R&D and acquisitions less the sale of PP&E: that is, [CAPX] + [XRD] + [ACQ] – [SPPE].

Table A.2: Firm characteristics of share repurchasing firms vs. non-share repurchasing firms

The table reports the mean and median of selected firm characteristics of share repurchasing firms and non-share repurchasing firms in the years 2010 (Panel A), 2005 (Panel B) and 2000 (Panel C), respectively. Share repurchase is measured by [PRSTKC] less any reduction in [PRTKRV]. Row [0] includes all non-financial and non-utility Compustat firms in a given year. Row [1] includes firms that repurchase shares in the present year; that is, firms for which share repurchase is positive in the present year. Row [2] includes firms that do not repurchase shares in the present year; that is, firms in Row [0] minus firms in Row [1]. Row [3] includes firms that do not repurchase shares in the current year and any year during the previous four years (t-4, t-1); that is, firms in Row [2] minus firms whose share repurchase is positive any year over (t-4, t-1). Row [4] includes firms that do not repurchase shares any year over the period (t-4, t+4); that is, firms in Row [3] minus firms that repurchase shares any year during the following four years (t+1, t+4). Definitions of firm characteristics are provided in Appendix Table A.1.

Panel A: Year 2010

		N	Q_{t-1}	$\log(TA_{t-1})$	ROA_{t-1}	RE_{t-1}/TA_{t-1}	$\Delta(\text{Paid-in capital})/TA_{t-1}$
[0]: All firms	Mean	2,783	1.87	20.16	0.0805	-0.5627	0.6647
	Median		1.39	20.11	0.1033	0.1261	0.0505
[1]: firms that repurchase shares in the present year	Mean	1,230	1.79	20.74	0.1253	-0.0399	0.1564
	Median		1.47	20.67	0.1229	0.2543	0.0065
[2]: [0] minus [1]	Mean	1,553	1.94	19.69	0.0438	-0.9859	1.0837
	Median		1.32	19.55	0.0824	0.0482	0.0997
[3]: [2] minus those that repurchase shares any year during (-4, -1)	Mean	892	2.24	19.34	0.0056	-1.5808	1.6721
	Median		1.40	19.25	0.0776	-0.0518	0.1462
[4]: [3] minus those that repurchase shares any year during (0, +4)	Mean	590	2.39	19.07	-0.0219	-2.1231	2.2948
	Median		1.43	18.88	0.0642	-0.1418	0.2299

Panel B: Year 2005

		N	Q_{t-1}	$\log(TA_{t-1})$	ROA_{t-1}	RE_{t-1}/TA_{t-1}	$\Delta(\text{Paid-in capital})/TA_{t-1}$
[0]: All firms	Mean	2,961	2.20	19.83	0.1291	-0.2418	0.7130
	Median		1.73	19.78	0.1388	0.1343	0.0826
[1]: firms that repurchase shares in the present year	Mean	1,207	2.18	20.71	0.1735	0.1251	0.1365
	Median		1.81	20.66	0.1616	0.2497	-0.0001
[2]: [0] minus [1]	Mean	1,754	2.22	19.23	0.0972	-0.5015	1.1454
	Median		1.66	19.14	0.1156	0.0332	0.1699
[3]: [2] minus those that repurchase shares any year during (-4, -1)	Mean	1,070	2.43	19.11	0.0834	-0.6166	1.5304
	Median		1.77	19.04	0.1146	-0.0185	0.2422
[4]: [3] minus those that repurchase shares any year during (0, +4)	Mean	644	2.42	18.87	0.0443	-0.7371	2.2186
	Median		1.76	18.68	0.1026	-0.0519	0.3499

Panel C: Year 2000

		N	Q_{t-1}	$\log(TA_{t-1})$	ROA_{t-1}	RE_{t-1}/TA_{t-1}	$\Delta (\text{Paid-in} \\ \text{-capital}) / \\ TA_{t-1}$
[0]: All firms	Mean	3,046	2.97	19.46	0.1169	-0.0164	0.9257
	Median		1.48	19.33	0.1486	0.1388	0.0967
[1]: firms that repurchase shares in the present year	Mean	1,419	2.49	19.98	0.1642	0.1968	0.3684
	Median		1.42	19.93	0.1751	0.2505	0.0338
[2]: [0] minus [1]	Mean	1,627	3.41	19.00	0.0725	-0.2059	1.4626
	Median		1.58	18.84	0.1230	0.0529	0.2664
[3]: [2] minus those that repurchase shares any year during (-4, -1)	Mean	1,081	4.03	18.92	0.0517	-0.2912	1.8248
	Median		1.90	18.77	0.1190	0.0000	0.3637
[4]: [3] minus those that repurchase shares any year during (0, +4)	Mean	713	3.87	18.79	0.0209	-0.3610	1.9019
	Median		1.78	18.63	0.1032	-0.0061	0.4261

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Figure 1: Graphical illustration of consecutive share repurchases over the period 1980-2017

The graph plots the means of two consecutive-share-repurchase dummy variables for each year over the period 1980-2017. The sample consists of non-financial and non-utility Compustat firms. REP_5YR_C is a dummy variable that equals 1 if a firm repurchases shares every year for the next four years and zero otherwise, conditional on the fact that the firm repurchases shares in the current year. Similarly, REP_3YR_C is 1 if a firm repurchases shares consecutively every year for the next two years, conditional on the fact that the firm repurchases shares in the current year. The mean of REP_nYR_C each year can be interpreted as the likelihood of a share repurchasing firm to continue to repurchase shares in at least n years consecutively. Share repurchase is measured by [PRSTKC] less any reduction in [PRTKRV]. Share repurchasing firms are defined as those for which the amount of share repurchase is positive.

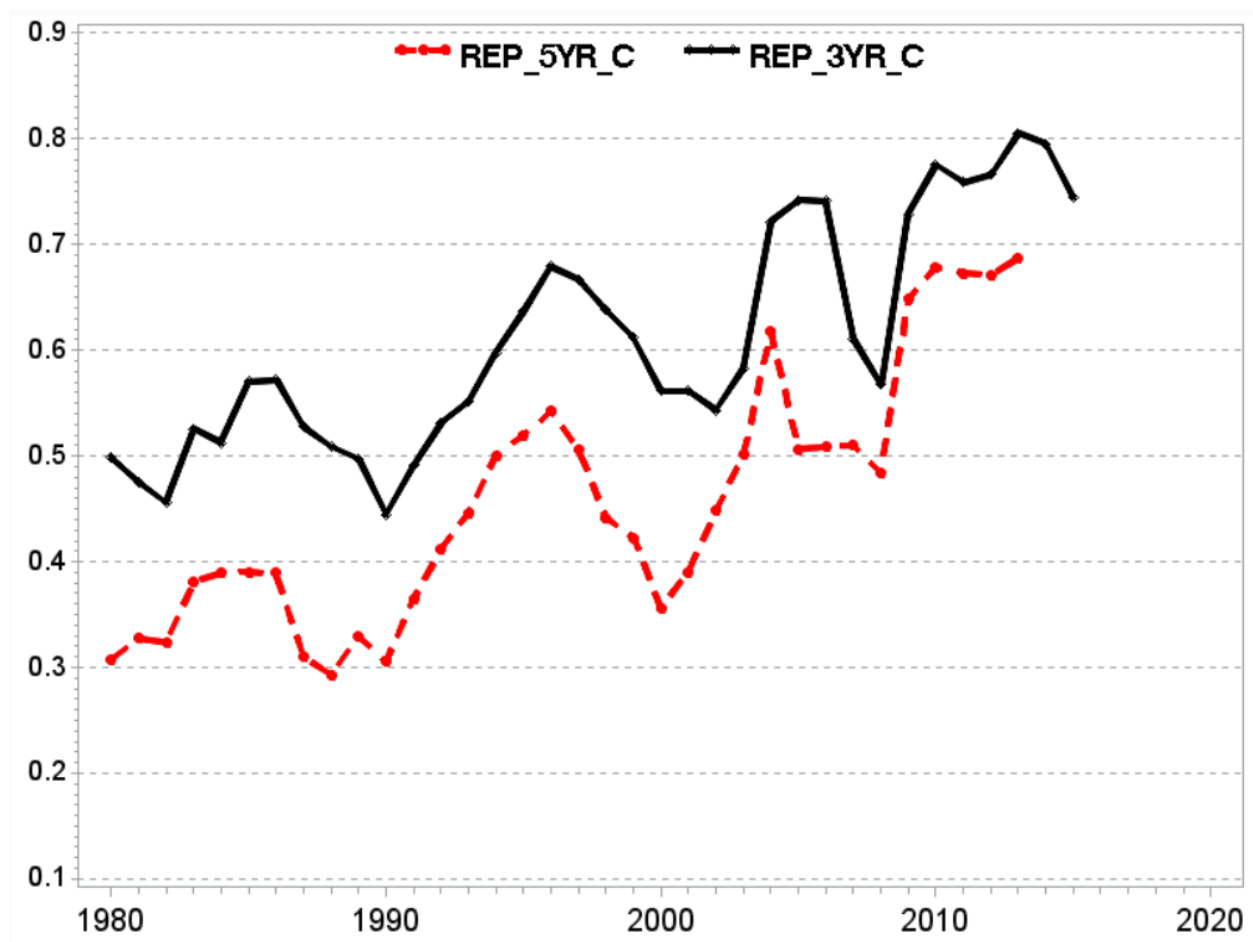
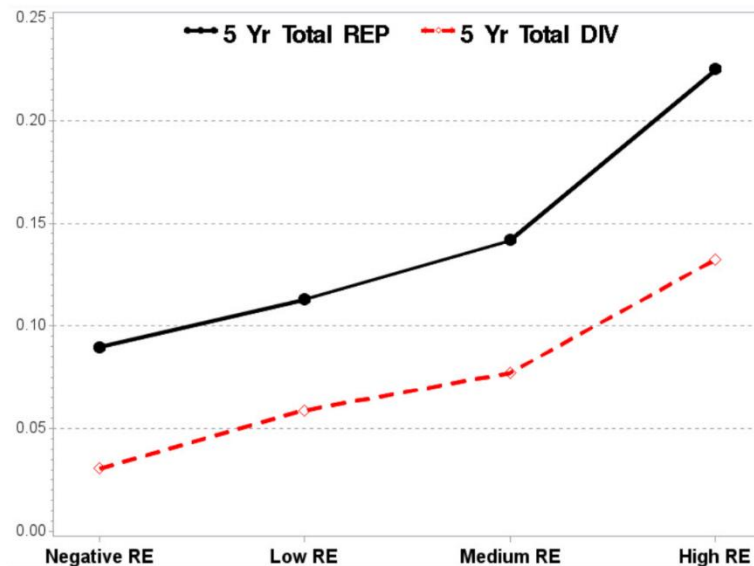


Figure 2: Share repurchases and dividends of subgroups classified by the financial life-cycle stage

The graphs plot the means of five-year total share repurchase (i.e., $\Sigma REP_{(t,t+4)} / TA_{t-1}$) and five-year total dividends (i.e., $\Sigma DIV_{(t,t+4)} / TA_{t-1}$) for the four groups of firms classified by retained earnings (RE_{t-1} / TA_{t-1}) for the period 1994-2017 (Panel A) and the period 1980-1994 (Panel B). The sample consists of non-financial and non-utility Compustat firms. To create these subgroups, we repeat the following procedure each year: we first separate negative-retained-earnings firms and then split non-negative-retained-earnings firms into three equally-sized subgroups by RE_{t-1} / TA_{t-1} .

Panel A: The period 1994-2017



Panel B: The period 1980-1993

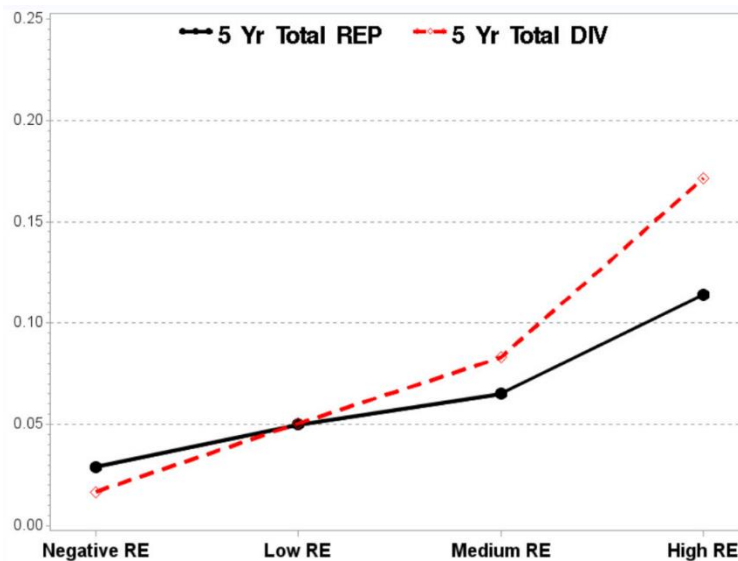
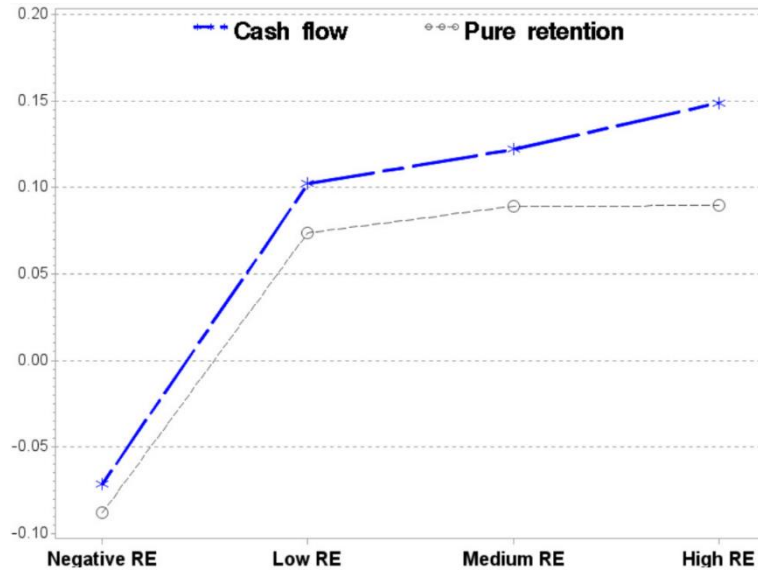


Figure 3: Cash flow and pure retention of subgroups classified by the financial life-cycle stage

The graphs plot the means of cash flow (i.e., CF_t / TA_{t-1}) and pure retention (i.e., $(CF_t - REP_t - DIV_t) / TA_{t-1}$) for the four groups of firms classified by retained earnings (RE_{t-1} / TA_{t-1}) for the period 1994-2017 (Panel A) and the period 1980-1994 (Panel B). The sample consists of non-financial and non-utility Compustat firms. To create these subgroups, we repeat the following procedure each year: we first separate negative retained-earnings firms and then split non-negative-retained-earnings firms into three equally-sized subgroups by RE_{t-1} / TA_{t-1} .

Panel A: The period 1994-2017



Panel B: The period 1980-1993

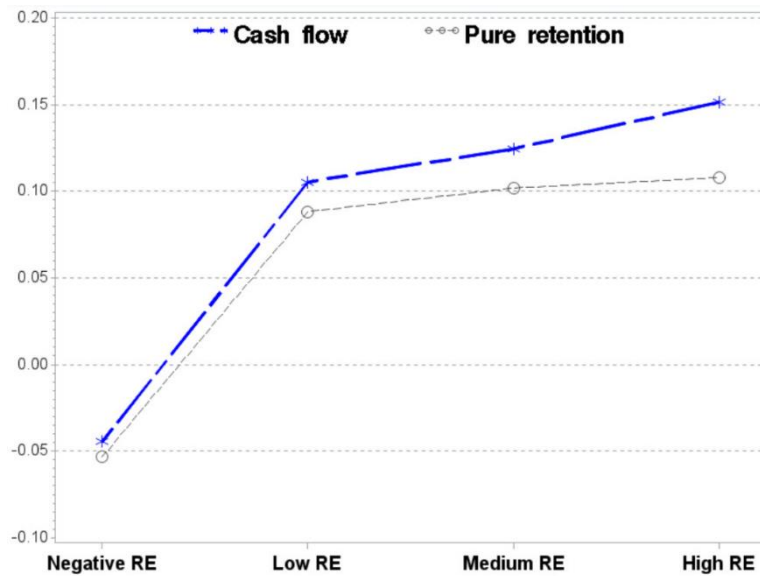


Figure 4: Trends of capital structure ratios for high-RE firms over the period 1996-2015

The graph plots the means of four capital structure ratios: the retained earnings-to-assets ratio (RE/TA), the paid-in-capital-to-assets ratio (PaidInCap/TA), the shareholders' equity-to-assets ratio (SHEQT/TA) and the debt-to-assets ratio (Debt/TA) for the high-RE firms over the four subperiods each consisting of five years over the period 1996-2015. The sample consists of non-financial and non-utility Compustat firms. We repeat the following procedure each year to identify the high-RE firms: we first separate negative retained earnings firms and then split non-negative-retained-earning firms into three equally size subgroups by RE_{t-1}/TA_{t-1} . The top tercile among non-negative-retained earnings firms is denoted as the high-RE firms.

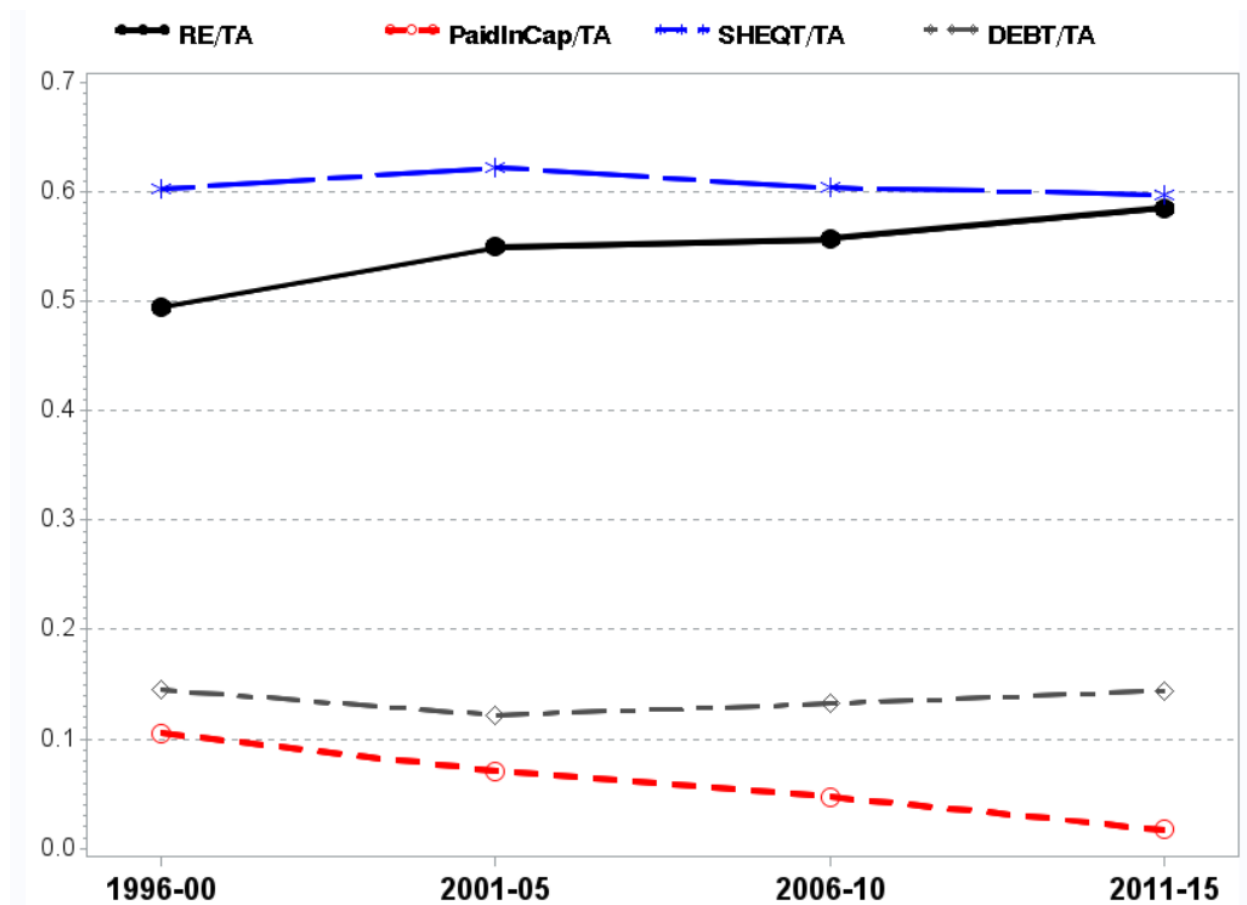


Table 1: Repeated share repurchase of Compustat firms over the period 1980-2017

The table reports the percentage of share repurchase firms and the means of consecutive-share-repurchase dummy variables for each year over the period 1980-2017. The sample includes non-financial and non-utility Compustat firms. The first column presents the percentage of share repurchasing firms each year. The next columns present the means of REP_nYR_C each year. REP_nYR_C is a dummy variable that equals 1 if a firm repurchases shares every year over the next $n-1$ years and zero otherwise, conditional on the fact that the firm repurchases shares in the current year. So by definition, REP_1YR_C is 1. As an example, REP_5YR_C is 1 if a firm repurchases shares consecutively every year for the next four years assuming that the firm repurchases shares in the current year. The mean of REP_nYR_C each year can be interpreted as the likelihood of a share repurchasing firm to continue to repurchase shares in at least n years consecutively. The amount of share repurchase is measured by [PRSTKC] less any reduction in [PRTKRV]. Share repurchasing firms are defined as those for which the amount of share repurchase is positive.

Year	The percentage of firms that repurchase shares	Mean of dummy variables that indicate that the firm repurchases shares consecutively for the next $n-1$ years conditional on the fact that the firm repurchases shares in the current year				
	Percentage	REP_1YR_C	REP_2YR_C	REP_3YR_C	REP_4YR_C	REP_5YR_C
1980	0.2715	1.0000	0.6048	0.4989	0.3590	0.3071
1981	0.2684	1.0000	0.7063	0.4752	0.3889	0.3279
1982	0.3105	1.0000	0.5962	0.4564	0.3785	0.3231
1983	0.2672	1.0000	0.6673	0.5258	0.4181	0.3815
1984	0.3274	1.0000	0.6848	0.5123	0.4560	0.3897
1985	0.3312	1.0000	0.6771	0.5707	0.4764	0.3903
1986	0.3286	1.0000	0.7546	0.5721	0.4590	0.3892
1987	0.4286	1.0000	0.6931	0.5275	0.4212	0.3103
1988	0.4009	1.0000	0.6678	0.5091	0.3697	0.2929
1989	0.3551	1.0000	0.7279	0.4973	0.3797	0.3299
1990	0.3963	1.0000	0.6329	0.4448	0.3646	0.3060
1991	0.3146	1.0000	0.6316	0.4908	0.4033	0.3650
1992	0.2820	1.0000	0.6714	0.5307	0.4607	0.4120
1993	0.2791	1.0000	0.6819	0.5520	0.4873	0.4462
1994	0.2919	1.0000	0.7232	0.5981	0.5305	0.5008
1995	0.3179	1.0000	0.7368	0.6368	0.5785	0.5197
1996	0.3391	1.0000	0.7721	0.6795	0.5822	0.5426
1997	0.3817	1.0000	0.8067	0.6670	0.5847	0.5068
1998	0.4764	1.0000	0.7643	0.6383	0.5247	0.4420
1999	0.4673	1.0000	0.7837	0.6115	0.4968	0.4228
2000	0.4659	1.0000	0.7284	0.5619	0.4602	0.3562
2001	0.4465	1.0000	0.7271	0.5619	0.4288	0.3905
2002	0.4258	1.0000	0.7387	0.5435	0.4838	0.4485
2003	0.3968	1.0000	0.6803	0.5824	0.5336	0.5011
2004	0.3675	1.0000	0.8067	0.7216	0.6651	0.6174

2005	0.4076	1.0000	0.8296	0.7419	0.6763	0.5066
2006	0.4407	1.0000	0.8329	0.7411	0.5498	0.5091
2007	0.4766	1.0000	0.8534	0.6107	0.5407	0.5101
2008	0.5324	1.0000	0.6752	0.5679	0.5259	0.4843
2009	0.4154	1.0000	0.7940	0.7290	0.6695	0.6493
2010	0.4420	1.0000	0.8638	0.7753	0.7210	0.6787
2011	0.4950	1.0000	0.8500	0.7592	0.7040	0.6732
2012	0.4956	1.0000	0.8411	0.7662	0.7219	0.6710
2013	0.4886	1.0000	0.8688	0.8054	0.7411	0.6875
2014	0.4981	1.0000	0.8880	0.7951	0.7232	-
2015	0.5146	1.0000	0.8524	0.7452	-	-
2016	0.4974	1.0000	0.8292	-	-	-
2017	0.4864	1.0000	-	-	-	-

Table 2: Logit regression of consecutive share repurchases

The table reports logit regression results that are estimated for non-financial and non-utility Compustat firms over the period 1980-2017. The dependent variables in these logit regressions are a range of dummy variables (*REP1C_DUM*, *REP2C_DUM*, *REP3C_DUM* and *REP4C_DUM*) that indicate whether firms repurchase shares in consecutive years. *REPnC_DUM* equals one if the firm repurchases shares consecutively for the next n years and zero otherwise. For example, *REP4C_DUM* equals one if the firm repurchases shares consecutively over the next four years and zero otherwise. A common explanatory variable in all regressions is *REP_DUM*, a dummy variable that indicates whether the firm repurchases shares in the current year. *Time* is an integer variable that takes the value 1 if the firm-year belongs to the first year of the sample, 2 if it belongs to the second year of the sample and so on. In Columns (2), (4), (6) and (8), *REP_DUM* × *Time* is the interaction of *REP_DUM* with *Time*. The amount of share repurchase is measured by [PRSTKC] less any reduction in [PRTKRV]. Share repurchasing firms are defined as those for which the amount of share repurchase is positive. The numbers in parentheses are t values based on firm-clustered standard errors. *, ** and *** indicate two-tailed significance at the 10%, 5% and 1% levels, respectively.

	Dependent variable							
	<i>REP1C_DUM</i>		<i>REP2C_DUM</i>		<i>REP3C_DUM</i>		<i>REP4C_DUM</i>	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>REP_DUM</i>	2.476*** (114.965)	2.187*** (69.022)	2.355*** (99.379)	2.123*** (59.386)	2.343*** (87.521)	2.154*** (53.135)	2.361*** (80.212)	2.218*** (48.938)
<i>Time</i>	0.036*** (24.583)	0.022*** (11.467)	0.041*** (21.903)	0.027*** (12.395)	0.045*** (19.165)	0.033*** (12.400)	0.048*** (16.812)	0.038*** (12.288)
<i>REP_DUM</i> × <i>Time</i>		0.028*** (10.521)		0.022*** (7.656)		0.017*** (5.380)		0.013*** (3.667)
Intercept	2.122*** (-33.440)	1.986*** (-32.951)	2.645*** (-39.318)	2.510*** (-38.596)	3.199*** (-41.302)	3.075*** (-40.716)	3.548*** (-41.641)	3.447*** (-41.212)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	No	No	No	No
N	100,441	100,441	97,504	97,504	94,531	94,531	91,596	91,596
Pseudo R ²	0.2560	0.2575	0.2352	0.2361	0.2248	0.2253	0.2178	0.2180

Table 3: Share repurchase continuity in our main sample of share-repurchase-announcement firms

The table reports the percentage of share repurchasing firms and the mean and median of the amount of share repurchases for the sample of share-repurchase announcement firms over the period 1994-2016. The table covers the five-year period $(t, t+4)$ starting with the announcement year (year t). Share repurchase announcements are identified from the SDC Platinum database. Specifically, share repurchase announcement is the firm-year in which INIT_AUTHOR is 1. We also use the Compustat database to ensure that the firm follows through with share repurchases. We filter out share repurchase announcement firms if these firms' actual share repurchases are zero in the announcement year and the following two years, where share repurchase is measured by [PRSTKC] less any reduction in [PRTKRV]. We also drop firms if their key firm characteristics such as cash and cash flow etc. are missing any year over the period $(t-4, t+4)$ around the announcement year. $\%(REP_{t+i}>0)$ is the percentage of firms that repurchase shares at year $t+i$, where $i=0, 1, 2, 3$ or 4 . $\%(REP_C_{(t,t+i)}>0)$ is the percentage of firms that repurchase shares consecutively from t to $t+i$, where $i=0, 1, 2, 3$ or 4 . REP_{t+i}/TA_{t-1} is the amount of share repurchases in a given year i scaled by the beginning-of-period book assets (i.e., TA_{t-1}). $\Sigma REP_{(t,t+i)}/TA_{t-1}$ is the cumulative amount of share repurchases up to a given year i scaled by TA_{t-1} . The amount of share repurchase is measured by [PRSTKC] less any reduction in [PRTKRV]. Panel A includes all share repurchasing announcement firms in the sample; Panel B includes only non-dividend payers among them; and Panel C includes only dividend payers among them.

Panel A: All share repurchase announcement firms

Year (i)		0	1	2	3	4
$\%(REP_{t+i}>0)$		100.00%	87.60%	80.06%	78.06%	76.00%
$\%(REP_C_{(t,t+i)}>0)$		100.00%	87.60%	75.47%	67.48%	61.11%
REP_{t+i}/TA_{t-1}	Mean	0.0708	0.0573	0.0484	0.0477	0.0448
	Median	0.0429	0.0307	0.0222	0.0203	0.0199
	N	2,242	2,242	2,242	2,242	2,242
$\Sigma REP_{(t,t+i)}/TA_{t-1}$	Mean	0.0708	0.1319	0.1884	0.2491	0.3116
	Median	0.0429	0.0894	0.1291	0.1717	0.2188
	N	2,242	2,242	2,242	2,242	2,242

Panel B: Non-dividend payers only

Year (i)		0	1	2	3	4
$\%(REP_{t+i}>0)$		100.00%	85.17%	76.35%	73.95%	74.45%
$\%(REP_C_{(t,t+i)}>0)$		100.00%	85.17%	71.54%	62.63%	57.41%
REP_{t+i}/TA_{t-1}	Mean	0.0768	0.0632	0.0503	0.0533	0.0520
	Median	0.0445	0.0295	0.0205	0.0215	0.0221
	N	998	998	998	998	998
$\Sigma REP_{(t,t+i)}/TA_{t-1}$	Mean	0.0768	0.1452	0.2064	0.2789	0.3568
	Median	0.0445	0.1022	0.1459	0.1922	0.2494
	N	998	998	998	998	998

Panel C: Dividend payers only

Year (i)	0	1	2	3	4	
$\%(REP_{t+i} > 0)$	100.00%	89.55%	83.04%	81.35%	77.25%	
$\%(REP_C_{(t,t+i)} > 0)$	100.00%	89.55%	78.62%	71.38%	64.07%	
REP_{t+i} / TA_{t-1}	Mean	0.0659	0.0525	0.0469	0.0433	0.0390
	Median	0.0421	0.0315	0.0236	0.0196	0.0174
	N	1,244	1,244	1,244	1,244	1,244
$\Sigma REP_{(t,t+i)} / TA_{t-1}$	Mean	0.0659	0.1213	0.1739	0.2253	0.2753
	Median	0.0421	0.0832	0.1208	0.1587	0.2010
	N	1,244	1,244	1,244	1,244	1,244

Table 4: Firm characteristics of share repurchase announcement firms

The table reports the mean and median of firm characteristics for share repurchase announcement firms as well as for top-half and bottom-half firms by the five-year sum of share repurchases (i.e., $\Sigma REP_{(t,t+4)} / TA_{t-1}$) among them. These firm characteristics are the beginning-of-the-year values of the share repurchase announcement years. The sample covers the period over the period 1994-2016. Share repurchase announcements are identified using the SDC Platinum database. Specifically, share repurchase announcement is the year in which INIT_AUTHOR is 1. We also use the Compustat database to ensure that the firm follows through with actual share repurchases. We filter out share repurchase announcement firms if these firms' actual share repurchases are zero in the announcement year and the following two years, where share repurchase is measured by [PRSTKC] less any reduction in [PRTKRV]. We also drop firms if their key firm characteristics such as cash and cash flow etc. are missing any year over the period ($t-4$, $t+4$) around the announcement year. We split the sample of share repurchase announcement firms into the top-half and bottom-half firms based on the five-year sum of share repurchases over (t , $t+4$) scaled by the beginning-of-period book assets (i.e., $\Sigma REP_{(t,t+4)} / TA_{t-1}$). *REP5C_DUM* is the dummy variable that equals one if the firm repurchases shares consecutively in the present year and subsequent next four years and zero otherwise. REP_t / TA_{t-1} is the amount of share repurchase in the present year scaled by the beginning-of-the year book assets. The definitions of the other variables are provided in Appendix Table A.1. "All" includes 2,242 firm-years; "Top-half" and "Bottom-half" include 1,121 firm-years each.

	All		Top half		Bottom half		Diff [Top - Bottom]	
	Mean	Median	Mean	Median	Mean	Median	Mean (t-stat)	Median (z-stat)
$\Sigma REP_{(t,t+4)} / TA_{t-1}$	0.3116	0.2188	0.5253	0.4418	0.0979	0.0910	0.4273***	0.3508***
<i>REP5C_DUM</i>	0.6111	1.0000	0.8046	1.0000	0.4175	0.0000	0.3872***	1.0000***
REP_t / TA_{t-1}	0.0708	0.0429	0.1092	0.0823	0.0323	0.0215	0.0769***	0.0609***
$\log(TA_{t-1})$	20.72	20.66	20.92	20.93	20.53	20.34	0.3888***	0.5897***
Q_{t-1}	2.08	1.72	2.51	2.15	1.65	1.42	0.8615***	0.7303***
<i>Ind. adj. Q</i> _{t-1}	-0.08	-0.23	0.29	0.07	-0.45	-0.44	0.7382***	0.5095***
<i>SRET</i> _{t-1}	0.2130	0.1298	0.2332	0.1477	0.1928	0.1014	0.0404*	0.0463***
<i>Ind. adj. SRET</i> _{t-1}	0.0862	0.0064	0.1121	0.0350	0.0603	-0.0282	0.0518**	0.0632***
<i>ROA</i> _{t-1}	0.1891	0.1747	0.2113	0.2011	0.1669	0.1556	0.0444***	0.0454***
<i>Sales growth</i> _{t-1}	0.1272	0.0925	0.1258	0.0900	0.1287	0.0953	-0.0029	-0.0053
<i>Asset growth</i> _{t-1}	0.1435	0.0781	0.1359	0.0770	0.1511	0.0789	-0.0152	-0.0019
$Cash_{t-1} / TA_{t-1}$	0.1682	0.1050	0.2066	0.1509	0.1298	0.0714	0.0769***	0.0796***
<i>Excess Cash</i> _t	0.0051	-0.0111	0.0102	-0.0097	-0.0002	-0.0132	0.0104**	0.0035
$Debt_{t-1} / TA_{t-1}$	0.1631	0.1368	0.1364	0.1022	0.1897	0.1729	0.0533***	0.0707***
RE_{t-1} / TA_{t-1}	0.3287	0.3484	0.3507	0.3887	0.3067	0.3082	0.0440***	0.0805***
$Dividend_{t-1} / TA_{t-2}$	0.0138	0.0040	0.0148	0.0000	0.0129	0.0064	0.0019*	-0.0064

Table 5: Tobit regressions of share repurchases

The table reports the results of Tobit regressions of the amount of share repurchases for the period spanning 1994-2017. In Panel A, the dependent variable is the amount of share repurchase in the current year scaled by lagged book assets (REP/TA_{t-1}); In Panel B, it is the sum of share repurchases over five years including the current year and the following four years scaled by the beginning-of-period book assets ($\Sigma REP_{(t,t+4)}/TA_{t-1}$). These regressions are estimated on the sample that consists of the share repurchase announcement firms and non-share repurchasing firms in the non-financial and non-utility Compustat universe. The amount of share repurchase is measured by [PRSTKC] less any reduction in [PRTKRV]. Industry-fixed effects are based on the Fama-French 48 industries classification. *Time* is an integer variable that takes the value 1 if the firm-year belongs to the first year of the sample, 2 if it belongs to the second year of the sample and so on. The numbers in parentheses are t values based on firm-clustered standard errors. *, ** and *** indicate two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A: Current year's share repurchase is the dependent variable.

	Dependent variable: REP/TA_{t-1}					
	(1)	(2)	(3)	(4)	(5)	(6)
Q_{t-1}	0.011*** (5.185)		0.007** (2.506)	0.012*** (5.104)		0.007** (2.332)
$SRET_{t-1}$		0.000 (0.000)	-0.002 (-0.586)		0.001 (0.537)	-0.000 (-0.122)
$\log(TA_{t-1})$	0.019*** (10.430)	0.022*** (12.356)	0.016*** (8.071)	0.022*** (12.265)	0.024*** (13.702)	0.018*** (10.253)
<i>Time</i>	0.011*** (7.307)	0.004*** (2.957)	0.001 (0.719)	0.009*** (6.153)	0.004*** (3.255)	0.002 (1.195)
ROA_{t-1}			0.197*** (7.099)			0.179*** (6.343)
$Cash_{t-1}/TA_{t-1}$			0.122*** (6.329)			0.115*** (5.901)
$Debt_{t-1}/TA_{t-1}$			-0.073*** (-3.725)			-0.089*** (-4.922)
RE_{t-1}/TE_{t-1}			0.023*** (5.688)			0.021*** (5.278)
$RETVOL_{t-1}$			-0.324*** (-6.988)			-0.301*** (-6.809)
$Dividend_{t-1}/TA_{t-2}$			-0.374*** (-2.982)			-0.346*** (-2.682)
Intercept	-0.448*** (-12.059)	-0.455*** (-12.269)	-0.342*** (-8.933)	-0.590*** (-10.145)	-0.584*** (-11.347)	-0.482*** (-9.073)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	Yes	Yes	Yes
N	5,559	4,169	4,159	5,500	4,124	4,114
Pseudo R ²	1.9006	-1.0194	-1.9709	3.3065	-1.3491	-2.1752

Panel B: Five-year sum of share repurchases is the dependent variable

	Dependent variable: $\Sigma REP_{(t,t+4)} / TA_{t-1}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Q_{t-1}	0.053*** (5.686)		0.047*** (4.097)	0.057*** (5.669)		0.043*** (3.779)
$SRET_{t-1}$		0.003 (0.333)	-0.017 (-1.417)		0.009 (0.925)	-0.010 (-0.779)
$\log(TA_{t-1})$	0.083*** (10.774)	0.100*** (12.515)	0.073*** (9.090)	0.097*** (12.491)	0.107*** (13.786)	0.081*** (11.624)
$Time$	0.047*** (7.368)	0.018*** (3.172)	0.008 (1.546)	0.038*** (6.356)	0.019*** (3.581)	0.010** (2.085)
ROA_{t-1}			0.840*** (7.438)			0.774*** (6.814)
$Cash_{t-1} / TA_{t-1}$			0.478*** (6.040)			0.442*** (5.573)
$Debt_{t-1} / TA_{t-1}$			-0.274*** (-3.506)			-0.325*** (-4.488)
RE_{t-1} / TE_{t-1}			0.080*** (5.095)			0.070*** (4.623)
$RETVOL_{t-1}$			-1.222*** (-6.505)			-1.110*** (-6.303)
$Dividend_{t-1} / TA_{t-2}$			-1.879*** (-3.418)			-1.661*** (-2.877)
Intercept	-1.966*** (-12.306)	-1.997*** (-12.464)	-1.584*** (-10.090)	-2.440*** (-8.748)	-2.413*** (-9.535)	-2.037*** (-8.322)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	Yes	Yes	Yes
N	5,559	4,169	4,159	5,500	4,124	4,114
Pseudo R ²	0.1810	0.2197	0.4446	0.3100	0.3028	0.5047

Table 6: Five-year changes of firm characteristics after share repurchase announcements

The table reports the mean and median of five-year changes of various firm characteristics for share repurchase announcement firms as well as for top-half and bottom-half firms by the five-year sum of share repurchases (i.e., $\Sigma REP_{(t,t+4)}/TA_{t-1}$) among them. The sample covers the period over the period 1994-2016. Share repurchase announcements are identified using the SDC Platinum database. Specifically, share repurchase announcement is the year in which INIT_AUTHOR is 1. We also use the Compustat database to ensure that the firm follows through with actual share repurchases. We filter out share repurchase announcement firms if these firms' actual share repurchases are zero in the announcement year and the following two years, where share repurchase is measured by [PRSTKC] less any reduction in [PRTKRV]. We also drop firms if their key firm characteristics such as cash and cash flow etc. are missing any year over the period ($t-4, t+4$) around the announcement year. We split the sample of share repurchase announcement firms into top-half and bottom-half firms based on the five-year sum of share repurchases over (0, +4) scaled by the beginning-of-period book assets (TA_{t-1}) (i.e., $\Sigma REP_{(t,t+4)}/TA_{t-1}$). $\Delta X_{(t-1,t+4)}$ is the change in a given variable over five years from $t-1$ to $t+4$. $\Sigma X_{(t,t+4)}$ is the cumulative sum of a given variable over five years from t to $t+4$. The definitions of the variables are provided in Appendix Table A.1. "All" includes 2,242 firm-years; "Top-half" and "Bottom-half" include 1,121 firm-years each.

	All		Top half		Bottom half		Diff [Top - Bottom]	
	Mean	Median	Mean	Median	Mean	Median	Mean (t-stat)	Median (z-stat)
$\Sigma REP_{(t,t+4)}/TA_{t-1}$	0.3116	0.2188	0.5253	0.4418	0.0979	0.0910	0.4273***	0.3508***
$REP5C_DUM$	0.6111	1.0000	0.8046	1.0000	0.4175	0.0000	0.3872***	1.0000***
REP_t/TA_{t-1}	0.0708	0.0429	0.1092	0.0823	0.0323	0.0215	0.0769***	0.0609***
$\Delta TA_{(t-1,t+4)}/TA_{t-1}$	0.5167	0.3316	0.5814	0.3608	0.4521	0.2917	0.1293***	0.0691***
$\Delta Sales_{(t-1,t+4)}/Sales_{t-1}$	0.4174	0.2986	0.4625	0.3401	0.3722	0.2521	0.0903***	0.0880***
$\Sigma CF_{(t,t+4)}/TA_{t-1}$	0.7009	0.6442	0.8630	0.7927	0.5389	0.4951	0.3242***	0.2976***
$\Delta Cash_{(t-1,t+4)}/TA_{t-1}$	0.0568	0.0196	0.0724	0.0225	0.0412	0.0170	0.0312***	0.0055**
$\Delta PPE_{(t-1,t+4)}/TA_{t-1}$	0.0998	0.0420	0.0985	0.0452	0.1010	0.0385	-0.0024	0.0067*
$\Delta RE_{(t-1,t+4)}/TA_{t-1}$	0.2181	0.1939	0.2926	0.2735	0.1436	0.1184	0.1489***	0.1551***
$(\Delta RE_{(t-1,t+4)} + \Sigma DIV_{(t,t+4)})/TA_{t-1}$	0.3114	0.2880	0.3990	0.3743	0.2239	0.1965	0.1750***	0.1778***
$\Delta(Paid-in-capital)_{(t-1,t+4)}/TA_{t-1}$	-0.0225	-0.0237	-0.0798	-0.1348	0.0348	-0.0002	-0.1146***	-0.1345***
$\Delta SEQ_{(t-1,t+4)}/TA_{t-1}$	0.2149	0.1117	0.2400	0.1062	0.1898	0.1155	0.0502***	-0.0093
$\Delta Debt_{(t-1,t+4)}/TA_{t-1}$	0.1267	0.0439	0.1403	0.0614	0.1132	0.0266	0.0271***	0.0348***
$\Delta(D/A)_{(t-1,t+4)}$	0.0299	0.0034	0.0465	0.0142	0.0133	0.0000	0.0332***	0.0142***
$\Sigma DIV_{(t,t+4)}/TA_{t-1}$	0.0888	0.0481	0.1006	0.0590	0.0770	0.0461	0.0236***	0.0130**

Table 7: Capital structure and related components over (t-4, t+4) of top-half share repurchasing firms

The table reports the mean and median of capital structure components along with cash reserves each year over the period (t-4, t+4) around the share repurchase announcement year (i.e., year t). The sample covers the period over the period 1994-2016. The tabulation includes only top-half share repurchase firms among share repurchase announcement firms, where top-half share repurchase firms are the firm-years for which the five-year sum of share repurchases over (t, t+4) scaled by the beginning-of-period book assets (TA_{t-1}) is above the median. The sample includes share repurchase announcement firms that are identified using the SDC Platinum database. Specifically, share repurchase announcement is the year in which INIT_AUTHOR is 1. We also use the Compustat database to ensure that the firm follows through with actual share repurchases. We filter out share repurchase announcement firms if these firms' actual share repurchases are zero in the announcement year and the following two years, where share repurchase is measured by [PRSTKC] less any reduction in [PRTKRV]. We also drop firms if their key firm characteristics such as cash and cash flow etc. are missing any year over the period (t-4, t+4) around the announcement year. Panel A includes top-half share repurchasing firms among all share-repurchase announcement firms; Panel B includes the top-half share repurchasing firms among non-dividend paying share-repurchase announcement firms; and Panel C includes top-half share repurchasing firms among dividend payers. N is the number of firm-year observations. The definitions of the variables are provided in Appendix Table A.1.

Panel A: The top-half repurchasing firms in the announcement sample

		t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
<i>Paid-in-capital / TA</i>	Mean	0.3096	0.2846	0.2630	0.2316	0.1780	0.1417	0.1207	0.0961	0.0737
	Median	0.2003	0.1955	0.1769	0.1672	0.1288	0.0920	0.0750	0.0506	0.0329
	N	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121
<i>RE / TA</i>	Mean	0.2557	0.2829	0.3133	0.3507	0.3856	0.4080	0.4201	0.4307	0.4409
	Median	0.3280	0.3512	0.3662	0.3887	0.4101	0.4276	0.4390	0.4407	0.4452
	N	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121
<i>SEQ / TA</i>	Mean	0.5631	0.5663	0.5753	0.5808	0.5634	0.5503	0.5407	0.5287	0.5181
	Median	0.5597	0.5655	0.5759	0.5820	0.5661	0.5521	0.5403	0.5253	0.5113
	N	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121
<i>Debt / TA</i>	Mean	0.1571	0.1526	0.1430	0.1364	0.1492	0.1600	0.1664	0.1742	0.1830
	Median	0.1234	0.1231	0.1153	0.1022	0.1183	0.1300	0.1348	0.1499	0.1579
	N	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121
<i>Cash / TA</i>	Mean	0.1968	0.2004	0.2057	0.2066	0.1990	0.1930	0.1895	0.1861	0.1874
	Median	0.1253	0.1348	0.1460	0.1509	0.1478	0.1411	0.1426	0.1372	0.1410
	N	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121

Panel B: The top-half repurchasing firms among non-dividend-paying firms in the announcement sample

		<i>t</i> -4	<i>t</i> -3	<i>t</i> -2	<i>t</i> -1	<i>t</i>	<i>t</i> +1	<i>t</i> +2	<i>t</i> +3	<i>t</i> +4
<i>Paid-in-capital / TA</i>	Mean	0.5352	0.4977	0.4645	0.4164	0.3497	0.3027	0.2782	0.2416	0.2115
	Median	0.3538	0.3294	0.3121	0.2908	0.2467	0.2187	0.2000	0.1824	0.1505
	N	499	499	499	499	499	499	499	499	499
<i>RE / TA</i>	Mean	0.0807	0.1186	0.1644	0.2252	0.2769	0.3124	0.3335	0.3543	0.3721
	Median	0.2034	0.2327	0.2609	0.3048	0.3458	0.3680	0.3917	0.4061	0.4079
	N	499	499	499	499	499	499	499	499	499
<i>SEQ / TA</i>	Mean	0.6130	0.6164	0.6296	0.6414	0.6279	0.6185	0.6130	0.6010	0.5905
	Median	0.6234	0.6276	0.6438	0.6527	0.6359	0.6359	0.6449	0.6276	0.6188
	N	499	499	499	499	499	499	499	499	499
<i>Debt / TA</i>	Mean	0.1355	0.1301	0.1181	0.1090	0.1189	0.1238	0.1263	0.1323	0.1408
	Median	0.0674	0.0722	0.0643	0.0475	0.0514	0.0505	0.0569	0.0714	0.0839
	N	499	499	499	499	499	499	499	499	499
<i>Cash / TA</i>	Mean	0.2748	0.2756	0.2795	0.2773	0.2669	0.2559	0.2488	0.2471	0.2487
	Median	0.2265	0.2515	0.2520	0.2543	0.2437	0.2326	0.2265	0.2191	0.2271
	N	499	499	499	499	499	499	499	499	499

Panel C: The top-half repurchasing firms among dividend-paying firms in the announcement sample

		<i>t</i> -4	<i>t</i> -3	<i>t</i> -2	<i>t</i> -1	<i>t</i>	<i>t</i> +1	<i>t</i> +2	<i>t</i> +3	<i>t</i> +4
<i>Paid-in-capital / TA</i>	Mean	0.1029	0.0905	0.0774	0.0611	0.0191	-0.0094	-0.0289	-0.0453	-0.0609
	Median	0.0792	0.0732	0.0704	0.0664	0.0344	0.0166	0.0039	0.0006	-0.0017
	N	622	622	622	622	622	622	622	622	622
<i>RE / TA</i>	Mean	0.4225	0.4372	0.4550	0.4730	0.4937	0.5066	0.5119	0.5145	0.5169
	Median	0.4350	0.4431	0.4487	0.4684	0.4757	0.4797	0.4841	0.4846	0.4790
	N	622	622	622	622	622	622	622	622	622
<i>SEQ / TA</i>	Mean	0.5237	0.5255	0.5299	0.5316	0.5115	0.4957	0.4817	0.4687	0.4571
	Median	0.5061	0.5110	0.5188	0.5211	0.4986	0.4870	0.4723	0.4488	0.4323
	N	622	622	622	622	622	622	622	622	622
<i>Debt / TA</i>	Mean	0.1744	0.1710	0.1643	0.1585	0.1725	0.1873	0.1986	0.2096	0.2199
	Median	0.1495	0.1582	0.1519	0.1368	0.1495	0.1697	0.1812	0.1960	0.2094
	N	622	622	622	622	622	622	622	622	622
<i>Cash / TA</i>	Mean	0.1299	0.1349	0.1413	0.1455	0.1399	0.1381	0.1366	0.1327	0.1337
	Median	0.0810	0.0887	0.0972	0.1024	0.0994	0.0914	0.0946	0.0931	0.0906
	N	622	622	622	622	622	622	622	622	622

Table 8: Allocation of share repurchases over the window (t, t+4)

Panel A shows how the share-repurchase-announcement firms allocate their share repurchases each year over the five-year window (t, t+4). REP_{t+i}/TA_{t-1} is the amount of share repurchase in a given year i (=1, 2, 3, 4 or 5) scaled by book assets at the beginning of five-year window. $W_REP_{t+i}(\text{over } 5 \text{ yrs})$ is the weight of share repurchase at year i in the total share repurchase over the five year window (i.e., $\sum REP_{(t,t+4)} / TA_{t-1}$). $W_REP_{t+i}(\text{over } 4 \text{ yrs})$ is the weight of share repurchase at year i in the total share repurchase over the four year window (i.e., $\sum REP_{(t+1,t+4)} / TA_{t-1}$). $(CF_{t+i}-REP_{t+i})/TA_{t-1}$ and $(CF_{t+i}-REP_{t+i}-DIV_{t+i})/TA_{t-1}$ are the residual cash flow after repurchasing shares and that after repurchasing shares and paying dividends, respectively. In Panel B, we assign each year over (t, t+4) to either of the two groups, high-cash-flow (High-CF) and low-cash-flow (Low-CF) years, based on whether the firm's cash flow in a given year is above or below the period mean or median of cash flow, CF_{t+i}/TA_{t-1} , measured by over the five-year window. In Panel C, we repeat the assignment to high- and low-cash-flow years over the four-year window (t+1, t+4). The sample covers the period over the period 1994-2016. Share repurchase announcements are identified using the SDC Platinum database. REP_t/TA_{t-1} is the amount of share repurchase in the present year scaled by the beginning-of-the year book assets. The definitions of the other variables are provided in Appendix Table A.1.

Panel A: Share repurchases and other variables each year over the window (t, t+4)

		t	t+1	t+2	t+3	t+4
REP_{t+i} / TA_{t-1}	Mean	0.0708	0.0622	0.0569	0.0620	0.0641
	Median	0.0429	0.0333	0.0259	0.0247	0.0249
$W_REP_{t+i}(\text{over } 5 \text{ yrs})$	Mean	31.01%	20.57%	15.88%	15.56%	16.98%
	Median	23.57%	17.11%	12.98%	13.04%	13.29%
$W_REP_{t+i}(\text{over } 4 \text{ yrs})$	Mean	-	32.47%	22.29%	21.30%	23.94%
	Median	-	24.75%	18.72%	19.60%	19.39%
$(CF_{t+i}-REP_{t+i})/TA_{t-1}$	Mean	0.0584	0.0682	0.0797	0.0855	0.0942
	Median	0.0662	0.0715	0.0801	0.0809	0.0851
$(CF_{t+i}-REP_{t+i}-DIV_{t+i})/TA_{t-1}$	Mean	0.0438	0.0514	0.0610	0.0663	0.0717
	Median	0.0508	0.0545	0.0617	0.0617	0.0637
% of firms with $(CF_{t+i}-REP_{t+i}) > 0$		81.27%	82.25%	83.76%	82.78%	84.08%
% of firms with $(CF_{t+i}-REP_{t+i}-DIV_{t+i}) > 0$		77.21%	78.55%	79.17%	78.37%	79.13%

Panel B: Analysis for the five-year period (t, t+4)

		Based on the-period-mean		Based on the-period-median	
		High-CF years	Low-CF years	High-CF years	Low-CF years
CF_{t+i} / TA_{t-1}	Mean	0.1775	0.1003	0.1891	0.1074
	Median	0.1550	0.1030	0.1623	0.1069
$W_REP_{t+i}(\text{over } 5 \text{ yrs})$	Mean	0.2248	0.1737	0.2342	0.1772
	Median	0.1885	0.1269	0.1973	0.1326
REP_{t+i} / TA_{t-1}	Mean	0.0720	0.0539	0.0755	0.0550
	Median	0.0386	0.0248	0.0412	0.0251
$(CF_{t+i}-REP_{t+i})/TA_{t-1}$	Mean	0.1048	0.0539	0.1126	0.0536
	Median	0.0942	0.0248	0.1006	0.0621
$(CF_{t+i}-REP_{t+i}-DIV_{t+i})/TA_{t-1}$	Mean	0.0853	0.0307	0.0922	0.0366
	Median	0.0741	0.0424	0.0804	0.0450

Panel C: Analysis for the four-year period ($t+1, t+4$)

		Based on the-period-mean		Based on the-period-median	
		High-CF years	Low-CF years	High-CF years	Low-CF years
CF_{t+i} / TA_{t-1}	Mean	0.1780	0.1050	0.1818	0.1037
	Median	0.1541	0.1064	0.1566	0.1042
W_REP_{t+i} (over 4 yrs)	Mean	0.2792	0.2188	0.2823	0.2177
	Median	0.2376	0.1729	0.2421	0.1672
REP_{t+i} / TA_{t-1}	Mean	0.0685	0.0536	0.0703	0.0523
	Median	0.0331	0.0228	0.0353	0.0215
$(CF_{t+i} - REP_{t+i}) / TA_{t-1+i}$	Mean	0.1086	0.0533	0.1108	0.0530
	Median	0.0958	0.0628	0.0978	0.0618
$(CF_{t+i} - REP_{t+i} - DIV_{t+i}) / TA_{t-1}$	Mean	0.0885	0.0349	0.0901	0.0351
	Median	0.0755	0.0449	0.0774	0.0444

Table 9: Comparing sensitivities of investments and share repurchases to cash flow

The table reports the results of regressions of investments, share repurchases and dividends, respectively. The estimations are performed on the share repurchase announcement firms that are identified using the SDC Platinum database over the period 1994-2016. More specifically, the regressions include firm-years that belong to the five-year window (t, t+4) for each share repurchase announcement year (t). All regressions include Tobin's Q (Q_{t+i-1}) and cash flow (CF_{t+i}/TA_{t+i-1}) as common explanatory variables for $i=0, 1, 2, 3$ and 4. In Panel A, the regression model is estimated with three dependent variables: (i) investment (the sum of capital expenditures, R&D and acquisitions) scaled by lagged assets ($INVEST_{t+i}/TA_{t+i-1}$), (ii) share repurchases (REP_{t+i}/TA_{t+i-1}) and (iii) dividends (REP_{t+i}/TA_{t+i-1}) for $i=0, 1, 2, 3$ and 4. Regressions are also estimated separately for non-dividend-paying and dividend-paying firms. In Panel B, regressions of investment are estimated with additional explanatory variables: the large-share-repurchase dummy and its interaction with cash flow. The large-share-repurchase-dummy (*Large_Repurchase*) equals 1 for firm-years in which the amount of share repurchase is above the mean annual share repurchase over the five-year window (t, t+4) and 0 for the other firm-years. All regressions control for both firm-fixed and year-fixed effects. The numbers in parentheses are t-values based on firm-clustered standard errors. N is the number of firm-years. *, ** and *** indicate two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A: Regressions of investments, share repurchases and dividends

	Entire sample firms			Non-dividend-paying firms only		Dividend-paying firms only	
	Investment	Repurchase	Dividend	Investment	Repurchase	Investment	Repurchase
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Q_{t+i-1}	0.034*** (8.605)	0.018*** (7.898)	0.003*** (5.774)	0.038*** (7.607)	0.018*** (6.305)	0.024*** (6.236)	0.018*** (4.856)
CF_{t+i}/TA_{t+i-1}	0.340*** (5.133)	0.245*** (6.744)	0.059*** (8.011)	0.243*** (2.769)	0.242*** (5.250)	0.516*** (8.206)	0.251*** (4.345)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2,242	2,242	2,242	998	998	1,244	1,244
Adjusted R ²	0.8231	0.6640	0.7454	0.7893	0.6475	0.8545	0.6779

Panel B: Regressions of investments with the large-share-repurchase dummy

	Dependent variable: $Invest_{t+i}/TA_{t+i-1}$					
	Entire sample firms		Non-dividend-paying firms only		Dividend-paying firms only	
	(1)	(2)	(3)	(4)	(5)	(6)
Q_{t+i-1}	0.033*** (8.682)	0.029*** (6.174)	0.037*** (7.843)	0.034*** (5.644)	0.023*** (6.089)	0.019*** (4.461)
CF_{t+i}/TA_{t+i-1}	0.320*** (4.804)	0.385*** (4.421)	0.216** (2.438)	0.273** (2.297)	0.503*** (7.994)	0.584*** (8.472)
<i>Large_Repurchase</i>	-0.011*** (-4.105)	-0.035*** (-3.335)	-0.014*** (-3.213)	-0.035*** (-2.640)	-0.008*** (-2.707)	-0.036** (-2.466)
$(CF_{t+i}/TA_{t+i-1}) \times Large_Repurchase$		-0.196** (-2.315)		-0.177 (-1.553)		-0.228** (-2.075)
N	2,242	2,242	998	998	1,244	1,244
Adjusted R ²	0.8248	0.8262	0.7921	0.7935	0.8555	0.8569

Table 10: Underinvestment or overinvestment of share repurchasing firms

The table's Panel A reports the relative frequency (i.e., likelihood) of underinvestment, normal investment and overinvestment for all share repurchase announcement firms (All), the top-half firms (High REP) and the bottom-half firms (Low REP). Share repurchase announcement firms are split into top- and bottom-half firms based on the size of share repurchases as measured by the five-year sum of share repurchases over $(t, t+4)$ scaled by the beginning-of-period book assets (TA_{t-1}). The sample covers the period over the period 1994-2016. Share repurchase announcement firms are identified from the SDC Platinum so they are defined as those that announce share repurchases. We measure the actual share repurchases of those announcement firms and measure the five-year sum of share repurchases (scaled by the beginning-of-period book assets). To determine underinvestment, normal investment and overinvestment, we classify share repurchasing firms into quartiles based on residuals from regressions. In the left part of each Panel, the regression model is $Investment_{i,t} = \alpha_0 + \alpha_1 Sales\ Growth_{i,t-1} + \varepsilon_{i,t+1}$, where the dependent variable is investment in year t scaled by TA_{t-1} . In the right part of each Panel, the regression model is $\Sigma Investment_{i,(t,t+4)} = \beta_0 + \beta_1 Sales\ Growth_{i,t-1} + \varepsilon_{i,(t,t+4)}$, where the dependent variable is five-year sum of investment over $(t, t+4)$ scaled by TA_{t-1} . Investment is total investment, as measured by $[CAPX] + [XRD] + [AQC] - [SPPE]$. The regressions are estimated using all non-financial and non-utility Compustat firms over the period 1994-2017. We use regression residuals (i.e., deviations from predicted investment) to sort firms' years into quartile. Firm-years in the bottom quartile (i.e., the most negative residuals) are classified as underinvesting, those in the middle two quartiles as the benchmark group, and those in the top quartile (i.e., the most positive residuals) as overinvesting. Then we tabulate the relative frequencies for share repurchasing firms and also matched firms. To help the reader understand the reported numbers, in Panel A, 20.7% is the percentage of underinvesting firms among all share repurchasing firms, 18.4% is the percentage of such firms among the top-half share repurchasing firms and 23.0% is the percentage of such firms among the bottom-half share repurchasing firms. Panels A and B report relative frequencies for two sets of matched firms: first based on firm size and second based on the combination of firm size and industry (FF 48 industries), respectively. These matched firms are selected among non-financial and non-utility Compustat firms that do not repurchase shares any year over the period $(t-4, t+4)$ around the year that our sample repurchase firm announces share repurchases. Share repurchases are measured by $[PRSTKC]$ less any reduction in $[PSTKRV]$. N is the number of firm-years. The sample covers the period 1994-2017. The definitions of the variables are provided in Appendix Table A.1.

Panel A: Share repurchase announcement firms

		1-year investment			5-year investment		
		All	High REP (Top half)	Low REP (Bottom half)	All	High REP (Top half)	Low REP (Bottom half)
Likelihood of underinvestment	N	445	199	246	417	198	219
	Prob (%)	20.7	18.4	23.0	19.4	18.3	20.5
Middle two quartiles	N	1,326	671	655	1,378	677	701
	Prob (%)	61.5	61.9	61.2	63.9	62.5	65.5
Likelihood of overinvestment	N	384	214	170	360	209	151
	Prob (%)	17.8	19.7	15.9	16.7	19.3	14.1

Panel B: Year-and-size matched firms

		1-year investment			5-year investment		
		All	High REP (Top half)	Low REP (Bottom half)	All	High REP (Top half)	Low REP (Bottom half)
Likelihood of underinvestment	N	389	194	195	419	213	206
	Prob (%)	19.8	19.8	19.7	21.3	21.7	20.9
Middle two quartiles	N	1,063	523	540	1,070	522	548
	Prob (%)	54.0	53.3	54.7	54.4	53.2	55.6
Likelihood of overinvestment	N	518	265	253	478	247	231
	Prob (%)	26.3	27.0	25.6	24.3	25.2	23.5

Panel C: Year-industry-and-size-matched firms

		1-year investment			5-year investment		
		All	High REP (Top half)	Low REP (Bottom half)	All	High REP (Top half)	Low REP (Bottom half)
Likelihood of underinvestment	N	322	186	136	314	171	143
	Prob (%)	30.2	33.6	26.4	29.5	30.9	27.9
Middle two quartiles	N	492	230	262	530	268	262
	Prob (%)	46.1	41.6	50.9	49.7	48.5	51.1
Likelihood of overinvestment	N	254	137	117	222	114	108
	Prob (%)	23.8	24.8	22.7	20.8	20.6	21.1

Table 11: Tobit regressions of Compustat firms' share repurchases for two sub-periods

The table reports the results of Tobit regressions of share repurchases for the two sub-periods: the period 1980-1993 and the period 1994-2017. These estimations are performed on the sample that consists of non-financial and non-utility Compustat firms. In Panel A, the dependent variable is the amount of share repurchase in the current year scaled by lagged book assets (REP_t/TA_{t-1}); in Panel B, it is the sum of share repurchases over five years ($t, t+4$) scaled by the beginning-of-period book assets ($\Sigma REP_{(t,t+4)}/TA_{t-1}$). The amount of share repurchase is measured by [PRSTKC] less any reduction in [PRTKRV]. Each panel reports two sets of regressions: one estimated for the period 1980-1993 and the other estimated for the period 1994-2017. In the last columns "the difference in coefficient estimates", the significance of the difference between the estimated coefficients of the two periods is determined using the Wald test. *Time* is an integer variable that takes the value 1 if the firm-year belongs to the first year of the sample, 2 if it belongs to the second year of the sample and so on. The definitions of the explanatory variables are provided in Appendix Table A.1. Industry-fixed effects are based on the Fama-French 48 industries classification. The numbers in parentheses are t values based on firm-clustered standard errors. *, ** and *** indicate two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A: The dependent variable is one-year share repurchase (REP_t/TA_{t-1})

	Estimation period: 1980-1993			Estimation period: 1994-2017			Difference in coefficient estimates		
	(1)	(2)	(3)	(4)	(5)	(6)	(4)-(1)	(5)-(2)	(6)-(3)
Q_{t-1}	0.0005 (0.669)		-0.003*** (-3.872)	0.033*** (6.739)		0.021*** (3.522)	0.032***		0.024***
$SRET_{t-1}$		0.001 (1.598)	0.002* (1.900)		0.035*** (6.501)	0.004 (0.746)		0.034***	0.002
$\log(TA_{t-1})$	0.005*** (13.106)	0.006*** (13.783)	0.005*** (10.082)	0.017*** (7.586)	0.018*** (6.518)	0.018*** (6.709)	0.012***	0.012***	0.013***
<i>Time</i>	0.002*** (9.409)	0.002*** (7.031)	0.002*** (5.968)	0.006*** (4.249)	0.001 (0.784)	0.004** (2.529)	0.004***	-0.001	0.002*
ROA_{t-1}			0.039*** (7.329)			0.245*** (5.847)			0.206***
$Cash_{t-1}/TA_{t-1}$			0.035*** (6.570)			0.128*** (4.368)			0.093***
$Debt_{t-1}/TA_{t-1}$			-0.036*** (-7.347)			-0.154*** (-6.140)			-0.118***
RE_{t-1}/TE_{t-1}			0.002* (1.714)			-0.002 (-0.312)			-0.004
$RETVOL_{t-1}$			-0.107*** (-8.096)			-0.156** (-2.522)			-0.049
$Dividend_{t-1}/TA_{t-2}$			0.017 (0.633)			-0.009 (-0.060)			-0.026
Intercept	-0.140*** (-9.120)	-0.151*** (-7.966)	-0.118*** (-6.590)	-0.483*** (-5.981)	-0.420*** (-4.901)	-0.493*** (-5.469)			
Year FE	Yes	Yes	Yes	Yes	Yes	Yes			
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes			
N	29,137	24,245	23,826	22,353	18,445	18,140			
Pseudo R ²	-0.1886	-0.1837	-0.2731	0.0925	0.0703	0.1642			

Panel B: The dependent variable is five-year share repurchase ($\Sigma REP_{(t,t+4)}/TA_{t-1}$)

	Estimation period: 1980-1993			Estimation period: 1994-2017			Difference in coefficient estimates		
	(1)	(2)	(3)	(4)	(5)	(6)	(4)-(1)	(5)-(2)	(6)-(3)
Q_{t-1}	0.007*** (13.334)		0.004*** (6.197)	0.074*** (13.375)		0.054*** (10.990)	0.067***		0.050***
$SRET_{t-1}$		0.002*** (3.057)	-0.003*** (-3.337)		0.057*** (10.349)	-0.002 (-0.407)		0.055***	0.001
$\log(TA_{t-1})$	0.010*** (25.257)	0.011*** (23.499)	0.010*** (21.217)	0.042*** (16.157)	0.047*** (15.303)	0.041*** (15.237)	0.032***	0.036***	0.031***
$Time$	0.003*** (14.651)	0.002*** (7.972)	0.001*** (6.007)	0.010*** (7.241)	0.003* (1.674)	0.004** (2.555)	0.007***	0.001**	0.003
ROA_{t-1}			0.087*** (16.331)			0.492*** (11.041)			0.405***
$Cash_{t-1} / TA_{t-1}$			0.052*** (11.788)			0.216*** (6.743)			0.164***
$Debt_{t-1} / TA_{t-1}$			-0.055*** (-12.857)			-0.220*** (-8.856)			-0.165***
RE_{t-1} / TE_{t-1}			0.001** (2.149)			0.002 (1.124)			0.001
$RETVOL_{t-1}$			-0.172*** (-18.493)			-0.401*** (-7.837)			-0.229***
$Dividend_{t-1} / TA_{t-2}$			-0.045** (-2.230)			-0.715*** (-5.423)			-0.670***
Intercept	-0.271*** (-20.922)	-0.275*** (-18.936)	-0.238*** (-17.847)	-1.044*** (-12.317)	-0.967*** (-11.878)	-0.948*** (-12.334)			
Year FE	Yes	Yes	Yes	Yes	Yes	Yes			
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes			
N	56,190	43,400	42,583	39,324	30,171	29,707			
Pseudo R ²	-0.3431	-0.2409	-0.4412	0.1060	0.1001	0.2825			

Table 12: Share repurchases for subgroups by the financial-life-cycle stage

The table reports the mean and median of share repurchase and dividend variables for the four subgroups of firms for the period 1994-2016 (Panel A) and the period (Panel B). The sample consists of non-financial and non-utility Compustat firms. To create these subgroups, we repeat the following procedure each year: we first separate negative-retained-earnings firms and then split non-negative-retained-earnings firms into three equally-sized subgroups by RE_{t-1}/TA_{t-1} . The definitions of the other variables are provided in Appendix Table A.1.

Panel A: The period 1994-2016

	Firms with Negative RE		Firms with positive RE					
			Terciles by RE ($= RE_{t-1}/TA_{t-1}$)					
			High RE		Medium RE		High RE	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
RE_{t-1}/TA_{t-1}	-1.0972	-0.3902	0.0871	0.0856	0.2690	0.2680	0.5497	0.5229
REP_t/TA_{t-1}	0.0099	0.0000	0.0145	0.0000	0.0194	0.0001	0.0354	0.0073
$\Sigma REP_{(t,t+4)}/TA_{t-1}$	0.0896	0.0031	0.1130	0.0241	0.1418	0.0486	0.2250	0.1211
REP_DUM_t	0.2887	0.0000	0.4148	0.0000	0.5076	1.0000	0.6406	1.0000
$REP5C_DUM$	0.1124	0.0000	0.1969	0.0000	0.2683	0.0000	0.3960	0.0000
DIV_t/TA_{t-1}	0.0039	0.0000	0.0097	0.0000	0.0120	0.0000	0.0203	0.0117
$\Sigma DIV_{(t,t+4)}/TA_{t-1}$	0.0306	0.0000	0.0589	0.0000	0.0771	0.0226	0.1323	0.0844
DIV_DUM_t	0.0979	0.0000	0.3469	0.0000	0.4769	0.0000	0.6195	1.0000
$DIV5C_DUM$	0.0634	0.0000	0.2715	0.0000	0.4234	0.0000	0.5775	1.0000
ROA_{t-1}	-0.0280	0.0453	0.1508	0.1337	0.1723	0.1548	0.2010	0.1858
Q_{t-1}	2.38	1.62	1.74	1.36	1.85	1.47	2.18	1.75
$Sales\ growth_{t-1}$	0.2658	0.0910	0.2241	0.1157	0.1527	0.1022	0.1003	0.0767
$Prob(\text{underinvestment})_t$	0.2825		0.2598		0.2217		0.2306	
CF_t/TA_{t-1}	-0.0715	0.0088	0.1021	0.0888	0.1220	0.1102	0.1487	0.1379
$(CF_t - REP_t - DIV_t)/TA_{t-1}$	-0.0881	-0.0093	0.0739	0.0680	0.0890	0.0807	0.0896	0.0831

Panel B: The period 1980-1993

	Firms with Negative RE		Firms with positive RE					
			Terciles by RE ($= RE_{t-1}/TA_{t-1}$)					
			High RE		Medium RE		High RE	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
RE_{t-1}/TA_{t-1}	-0.5472	-0.2090	0.1288	0.1330	0.2996	0.3002	0.5325	0.5110
REP_t/TA_{t-1}	0.0047	0.0000	0.0064	0.0000	0.0085	0.0000	0.0151	0.0000
$\Sigma REP_{(t,t+4)}/TA_{t-1}$	0.0290	0.0000	0.0499	0.0023	0.0652	0.0133	0.1140	0.0384
REP_DUM_t	0.1717	0.0000	0.2797	0.0000	0.3501	0.0000	0.4476	0.0000
$REP5C_DUM$	0.0218	0.0000	0.0706	0.0000	0.1139	0.0000	0.2132	0.0000
DIV_t/TA_{t-1}	0.0022	0.0000	0.0081	0.0000	0.0130	0.0087	0.0267	0.0226
$\Sigma DIV_5YR/TA_{t-1}$	0.0167	0.0000	0.0505	0.0002	0.0830	0.0536	0.1714	0.1386
DIV_DUM_t	0.0758	0.0000	0.3989	0.0000	0.6256	1.0000	0.7914	1.0000

<i>DIV5_C_DUM</i>	0.0347	0.0000	0.3099	0.0000	0.5359	1.0000	0.7470	1.0000
<i>ROA_{t-1}</i>	-0.0046	0.0433	0.1627	0.1458	0.1827	0.1677	0.2137	0.2031
<i>Q_{t-1}</i>	2.23	1.39	1.51	1.19	1.49	1.19	1.71	1.36
<i>Sales growth_{t-1}</i>	0.3160	0.0974	0.2526	0.1405	0.1605	0.1158	0.1101	0.0935
<i>Prob(underinvestment)_t</i>	0.3662	-	0.2803	-	0.2110	-	0.2037	-
<i>CF_t / TA_{t-1}</i>	-0.0446	0.0107	0.1053	0.0933	0.1245	0.1133	0.1514	0.1427
<i>(CF_t - REP_t - DIV_t) / TA_{t-1}</i>	-0.0533	0.0035	0.0882	0.0797	0.1019	0.0919	0.1079	0.1020

Table 13: Compustat firms' investment- and share repurchase-cash flow sensitivities

The table reports the results of regressions of investment, share repurchases and dividends in Panels A, B and C, respectively. The estimations are performed on non-financial and non-utility Compustat firms over the period 1994-2016. In Panel A, the dependent variable is investments, defined as total investments (the sum of capital expenditures, R&D and acquisitions) scaled by lagged assets. All regressions include Tobin's Q (Q_{t-1}) and cash flow (CF_t/TA_{t-1}) as common explanatory variables. The regression model is estimated for the full sample as well as each of the four subgroups of firms classified by retained earnings (RE_{t-1}/TA_{t-1}). To create these subgroups, we repeat the following procedure each year: we first separate negative retained-earnings firms and then split non-negative-retained-earnings firms into three equally-sized subgroups by RE_{t-1}/TA_{t-1} . In Panels B and C, the dependent variables are share repurchases (REP_t/TA_{t-1}) and dividends (DIV_t/TA_{t-1}), respectively. Regressions control for both firm-fixed and year-fixed effects. The numbers in parentheses are t-values based on firm-clustered standard errors. N is the number of firm-years that are used for estimation. *, ** and *** indicate two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A: Regressions of Investments

	Dependent variable: $Invest_t / TA_{t-1}$				
	Entire sample	Negative RE	Positive RE		
			Terciles by RE ($= RE_{t-1}/TA_{t-1}$)		
			Low RE	Medium RE	High RE
(1)	(2)	(3)	(4)	(5)	
Q_{t-1}	0.070*** (155.526)	0.069*** (97.732)	0.062*** (58.771)	0.067*** (73.833)	0.071*** (68.583)
CF_t / TA_{t-1}	0.029*** (2.643)	-0.036*** (-2.964)	0.342*** (11.626)	0.243*** (9.584)	0.102*** (3.981)
Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
N	63,794	21,403	13,547	14,356	14,488
Adjusted R ²	0.5616	0.5056	0.5014	0.6372	0.7120

Panel B: Regressions of share repurchases

	Dependent variable: REP_t / TA_{t-1}				
	Entire sample	Negative RE	Positive RE		
			Terciles by RE ($= RE_{t-1}/TA_{t-1}$)		
			Low RE	Medium RE	High RE
(1)	(2)	(3)	(4)	(5)	
Q_{t-1}	0.007*** (94.930)	0.006*** (61.726)	0.008*** (43.759)	0.007*** (32.586)	0.005*** (15.924)
CF_t / TA_{t-1}	0.031*** (19.505)	0.027*** (16.493)	0.031*** (7.348)	0.043*** (7.579)	0.065*** (7.695)
Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
N	64,204	21,520	13,657	14,441	14,586
Adjusted R ²	0.2091	0.2771	0.2862	0.2382	0.0992

Panel C: Regressions of dividends

	Dependent variable: DIV_t / TA_{t-1}				
	Entire sample	Negative RE	Positive RE		
			Terciles by RE ($= RE_{t-1} / TA_{t-1}$)		
			Low RE	Medium RE	High RE
(1)	(2)	(3)	(4)	(5)	
Q_{t-1}	0.004*** (110.261)	0.004*** (70.863)	0.004*** (41.682)	0.004*** (38.549)	0.004*** (25.173)
CF_t / TA_{t-1}	0.016*** (20.114)	0.013*** (16.452)	0.025*** (9.231)	0.028*** (9.330)	0.025*** (5.326)
Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
N	64,204	21,520	13,657	14,441	14,586
Adjusted R ²	0.3050	0.3221	0.3372	0.3692	0.2256

Table 14: Compustat firms' trends in investment- and share repurchase-cash flow sensitivities

The table reports the results of regressions of investment, share repurchases and dividends in Panels A, B and C, respectively. The estimations are performed on non-financial and non-utility Compustat firms over the period 1980-2017. In Panel A, the regressions are estimated for the period 1980-2017 with three alternating dependent variables: investment ($Invest_t/TA_{t-1}$), share repurchases (REP_t/TA_{t-1}) and dividends (DIV_t/TA_{t-1}). All regressions include Tobin's Q (Q_{t-1}), cash flow (CF_t/TA_{t-1}), $Time$ and $CF_t/TA_{t-1} \times Time$ as explanatory variables. $Time$ is an integer variable that takes the value 1 if the firm-year belongs to the first year of the sample, 2 if it belongs to the second year of the sample and so on. $CF_t/TA_{t-1} \times Time$ is the interaction of cash flow with $Time$. The regression model is estimated for (i) the full sample, (ii) firm-years with non-negative retained earnings and (iii) firm-years that belong to the top tercile subgroup by (RE_{t-1}/TA_{t-1}) among firms with non-negative retained earnings. To create these subgroups, we repeat the following procedure each year: we first separate negative retained-earnings firms and then split non-negative-retained-earnings firms into three equally-sized subgroups by RE_{t-1}/TA_{t-1} . In Panel B, regressions are estimated for each selected ten-year period. *Invest-CF sensitivities*, *REP-CF sensitivities* and *DIV-CF sensitivities* are the coefficient on cash flow (CF_t/TA_{t-1}) in regressions of investment, share repurchases and dividends on Tobin's Q and cash flow. All regressions control for both firm-fixed and year-fixed effects. The numbers in parentheses are t-values based on firm-clustered standard errors. N is the number of firm-years that are used for estimation. *, ** and *** indicate two-tailed significance at the 10%, 5% and 1% levels, respectively.

Panel A: Regressions for the period 1980-2017

	Dep. var.: $Invest_t/TA_{t-1}$			Dep. var.: REP_t/TA_{t-1}			Dep. var.: DIV_t/TA_{t-1}		
	Entire sample	Non-negative RE firms	High-RE firms	Entire sample	Non-negative RE firm	High-RE firms	Entire sample	Non-negative RE firms	High-RE firms
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Q_{t-1}	0.058*** (83.325)	0.046*** (47.688)	0.040*** (25.558)	0.005*** (40.543)	0.006*** (25.795)	0.004*** (8.168)	0.004*** (44.385)	0.004*** (28.970)	0.004*** (14.049)
CF_t/TA_{t-1}	0.158*** (12.547)	0.586*** (31.616)	0.635*** (19.980)	0.024*** (14.658)	0.015*** (4.247)	0.020** (2.228)	0.027*** (25.778)	0.044*** (19.185)	0.038*** (6.941)
$Time$	-0.003*** (-31.033)	-0.004*** (-29.828)	-0.005*** (-27.949)	-0.0001*** (-5.824)	0.00001 (0.290)	0.0001 (1.255)	-0.0001*** (-7.370)	-0.00003 (-1.434)	0.00002 (0.407)
$(CF_t/TA_{t-1}) \times Time$	-0.009*** (-9.516)	-0.023*** (-18.966)	-0.029*** (-16.851)	0.0003 (1.388)	0.002*** (5.004)	0.002*** (3.582)	-0.0004*** (-3.432)	-0.001*** (-2.784)	-0.0001 (-0.168)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	95,153	68,086	23,389	95,947	68,688	23,559	95,947	68,688	23,559
Adj. R ²	0.5722	0.6271	0.7641	0.1743	0.1456	0.0700	0.3526	0.3616	0.2667

Panel B: Rolling regressions for selected ten-year periods

	<i>INVEST-CF sensitivities</i>			<i>REP-CF sensitivities</i>			<i>DIV-CF sensitivities</i>		
	Entire sample	Non-negative RE firms	High-RE firms	Entire sample	Non-negative RE firms	High-RE firms	Entire sample	Non-negative RE firms	High-RE firms
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1981-1990	0.327***	0.633***	0.488***	0.024***	0.028***	0.035***	0.035***	0.045***	0.049***

1986-1995	0.165***	0.443***	0.406***	0.017***	0.016***	0.017	0.020***	0.024***	0.025***
1991-2000	0.067***	0.365***	0.361***	0.019***	0.023***	0.039***	0.014***	0.019***	0.026***
1996-2005	0.045***	0.364***	0.252***	0.025***	0.033***	0.040***	0.010***	0.015***	0.014***
2001-2010	0.032**	0.260***	0.183***	0.031***	0.050***	0.068***	0.012***	0.024***	0.022***
2006-2015	-0.014	0.139***	0.013	0.028***	0.042***	0.063***	0.016***	0.024***	0.016**
