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Are Share Repurchases Really Flexible?

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Abstract

This article documents a trend of declining flexibility in share repurchase policies over the last 4 decades. We show that repurchases have become particularly sticky for firms with repurchase programs in place. We also exploit the additional inflexibility within existing repurchase programs to show that repurchase stickiness can have real effects for firms. Using the 2008 financial crisis as a shock to firms' ability to raise capital, we find that firms with ongoing share repurchase programs ending after Dec. 2007 reduced investment, employment, and R&D spending by more than similar firms with programs ending before the onset of the crisis.

I. Introduction

Share repurchase programs are playing an increasingly important role in firms' payout policies. In 1995, only 15% of publicly listed firms in the United States repurchased shares. This number increased to 45% by 2012. Meanwhile, the dollar amount of total share repurchases among publicly listed U.S. firms increased from $90 billion in real 2012 dollars in 1995 to $364 billion in 2012 (Farre-Mensa, Michaely, and Schmalz (2014)). Share repurchases have become the dominant form of corporate payout (Skinner (2008), Floyd, Li, and Skinner (2015)), in particular open market share repurchase programs, which represent more than 90% of all the share repurchase programs announced (Stephens and Weisbach (1998), Grullon and Michaely (2004)).

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Brav, Graham, Harvey, and Michaely (2005) survey 384 managers about their payout decisions. Managers report that they prefer open market share repurchases because share repurchase programs provide them with flexibility in the amount and timing of stock buybacks. In particular, managers do not have to repurchase the entire dollar amount announced in a new program and can let the repurchase programs expire or retire them instead. In contrast to the standard belief that repurchases are flexible, the literature has established that dividend policies are "sticky" (Michaely and Roberts (2012)). The evidence for dividend stickiness comes from Lintner-type regressions (Lintner (1956)), which show that lagged dividends have strong predictive power for current dividends, even after controlling for a proxy for firms' target dividends. In other words, firms display a low speed of adjustment (SOA) in their dividend policies: They do not appear to close much of the gap between current and target dividends when the dividend target changes.

Given the increasing popularity of share repurchase programs, it is surprising that the literature has not examined whether repurchase programs are really flexible or not. That is our goal in this article. Our evidence suggests that repurchases have become less flexible over time and that this financial inflexibility has potential consequences for real corporate policies.

We start by studying the SOA of share repurchase policies in the last 4 decades using a Lintner (1956) type of regression. As in the original Lintner model, we start with a specification in which the repurchase target depends not only on earnings but also consider alternative specifications in which the repurchase target also depends on other covariates such as cash, Q, size, and leverage. Consistent with standard belief, we observe very flexible share repurchase policies in the 1980s. On average, firms close 79% of the gap between target and current share repurchase levels within 1 year. But the SOA decreased monotonically over the years, reaching 53% in models estimated between 2010 and 2019. Notably, this SOA is still significantly greater than that of dividends (which is stable over the years and ranges from 16% to 22%). Thus, despite the increase in stickiness, share repurchases continue to be the more flexible option to return capital to investors when compared to dividends.

We also uncover significant heterogeneity in repurchase flexibility. Previous research has shown that firms tend to complete repurchase programs once they are announced (Stephens and Weisbach (1998)). It is, therefore, natural to expect that once a repurchase program is announced, managers may feel more pressure to maintain a certain level of actual repurchases in the duration of the program. Consistent with this expectation, we observe that for firms with share repurchase programs in place, the SOA decreases from around 55% during the 1990s to 29% during the 2010s. Strikingly, for firms with repurchase programs, the estimated SOA during the 2010 decade is economically similar to the SOA estimated for dividends (which is approximately 20%). For firms with repurchase programs in place, dividends and repurchases appear to have become almost equally (in)flexible. The evidence also suggests that there is more repurchase flexibility once an existing program expires: Managers can then set repurchase amounts closer to current target levels.

This increased inflexibility of repurchases does not necessarily mean that they have real effects on other policies such as real investments. Financially constrained firms can set repurchase programs to levels that do not compromise their ability to

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fund real investments. If that is the case, then the pressure to maintain a certain level of repurchases should not have real effects. On the other hand, the relative inflexibility of repurchases, once a program is in place, raises an interesting possibility: What if a firm with a repurchase program in place is hit with a significant and unexpected financial shock that undermines the firm's ability to raise capital? In that case, the firm may need to choose either abandoning the planned repurchases or maintaining the planned level of repurchases and cutting other expenditures.

The 2008 financial crisis provides us with a setting to examine this trade-off. The 2008 crisis was a large and unexpected shock to financial markets that affected firms' ability to raise capital, at least temporarily (Duchin, Ozbas, and Sensoy (2010), Giroud and Mueller (2016)). Firms with repurchase programs that were active in 2008 may have had to choose either repurchases or investments during the crisis period. Given that these programs are typically announced well ahead of time, these firms were unable to anticipate the financial crisis and may have become unexpectedly constrained (these firms are the treated firms in our analysis).[1]

To reliably estimate the trade-off between repurchases and investments during the crisis period, we also need a good counterfactual. Relative to treated firms, what would a similar firm do if it faced less pressure to conduct repurchases during the crisis? Notice, though, that focusing on firms that do not conduct repurchases at all is problematic because these firms are likely to differ systematically from the treated firms. For example, evidence suggests that repurchase announcements predict declines in capital expenditures (Grullon and Michaely (2004)), because firms are more likely to repurchase when they have excess cash and low growth opportunities. Thus, finding that firms that have repurchase programs in place invest less than other firms may not be evidence that repurchases affect investments. Rather, it could be the lack of investment opportunities that causes companies to repurchase.

To construct an appropriate counterfactual, we require control firms to also have open market share repurchase programs on the dates surrounding the 2008 financial crisis.[2] However, unlike treated firms, our control firms' repurchase programs expire *right before* the financial crisis. Given that a program's expiration enhances repurchase flexibility (as discussed previously), these firms may have been able to better adjust target repurchases to the new financial conditions in the aftermath of the financial crisis. This identification strategy resembles the strategy proposed by Almeida, Campello, Laranjeira, and Weisbenner (2012) to examine the effect of debt on investment during the 2008 crisis. While Almeida et al. (2012) use the timing of long-term debt maturity around the crisis period, we use the timing of expiration of existing repurchase programs. In both settings, this timing captures an element of luck: Control firms were fortunate to have repurchase programs expiring just in time to adjust repurchase levels for the crisis period.

Our identification strategy implicitly assumes that other than this difference in expiration timing, treated and control firms are similar. In particular, we stress that, like our treated firms, the control firms also conduct regular share repurchases. To

[1]Firms announce share repurchase programs that last 3 years on average according to SDC data. Thus, treated firms' share repurchase programs were put in place ahead of the financial crisis.

[2]We require treated and control firms to have announced share repurchase programs within 3 years before the financial crisis.

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ensure that our results are not arising from differences in repurchase levels, we also require that control firms' repurchase programs be of similar size to those of treated firms. In addition, we match treated and control firms on other potential sources of firm-level heterogeneity (firm size, *Q*, leverage, cash holdings, cash flow, and industry code) and examine within-firm changes in real outcomes around the crisis period. Our difference-in-differences matching estimator can thus account for observable firm characteristics and unobservable, time-invariant firm effects. Our identification assumption is that treated and control firms do not differ along an unobservable dimension that predicts changes in investments around the crisis period. In our setting, we believe that this assumption is reasonable.

We find evidence that firms do sacrifice real activities to fund their open market share repurchase programs. Firms with share repurchase programs in place after Dec. 2007 reduced their capital investment by about 27%, employment by 11%, and R&D expenditure by 17% of precrisis levels, when benchmarked against otherwise similar firms with share repurchase programs ending in or before Dec. 2007. The results suggest that firms are cutting their real activities to fund their open market share repurchase programs and that repurchase inflexibility does have real effects.[3]

A common concern with a difference-in-differences study is that precrisis trends across treated and control groups may be different (e.g., treated firms may already have been reducing investments prior to the crisis). To address this concern, we show that outcome variables for treated and control groups have no difference in preexisting trends in a dynamic analysis. We also utilize a continuous treatment combined with an instrumental variable approach to show that our findings are robust to this alternative identification strategy. Another concern is that there might be a latent variable that is driving the sharp treated-control contrast in the postcrisis period. While it is impossible to completely eliminate this possibility, appropriate placebo tests help rule out some potential explanations. We conduct such tests by assuming that a financial crisis took place in Dec. 2006. These tests show no statistically significant differences between the treated and control groups during the placebo periods. Additionally, we use the 2001 dotcom period as a further robustness check. In 2001, there was a recession but no credit supply shock. The goal is to differentiate the credit supply channel of the recent financial crisis. We do not find any differences in real activities between similarly constructed treated and control groups around 2001.

In addition, we provide statistics on actual repurchases conducted after the crisis. Our underlying hypothesis is that liquidity freed up by declines in investment helped fund share repurchases. We show that treated firms with decreases in investment, employment, and R&D expenses after Dec. 2007 have significantly higher completion rates than firms without decreases in real activities. The evidence suggests that downsizing real activity is a source of funding that allows firms to complete previously announced share repurchases. Similarly, firms that cut their

[3]By Dec. 2007, firms in our treated group on average repurchased less than 35% of the total approved amount in the announcement, in terms of both dollar value and number of shares. Thus, there can be a meaningful trade-off between approved repurchases and investments during the crisis period.

real activities during the crisis due to having an ongoing repurchase program have inferior performance in the years after the crisis.

Our article reports two facts that, to the best of our knowledge, are new to the literature on share repurchases in the United States: Repurchase flexibility has declined over time, and the announcement of a repurchase program reduces flexibility even further. Numerous papers have documented the SOA for dividends (e.g., Lintner (1956), Fama and Babiak (1968), Brav et al. (2005), Grullon and Michaely (2004), and Michaely and Roberts (2012)) using different time periods and sample firms. No paper that we know of has examined the SOA of share repurchases using U.S. firms. Von Eije and Megginson (2008) report the SOA of share repurchases to earnings using European data from 1996 to 2005, while Skinner (2008) studies the SOA of total payout as a combination of dividends and share repurchases. Our relative contribution to these two papers is twofold. First, we show that the SOA of repurchases has decreased over time and has become closer to the SOA of dividends. Second, we show evidence of additional inflexibility when firms are completing previously authorized programs.[4] If we examine firm-years in which repurchase programs are in place, the SOA of repurchases becomes very similar to the SOA of dividends in the 2010–2019 time period.

Importantly, we also exploit the differential (in)flexibility within programs to show that firms may choose to reduce real investments in order to fund an existing repurchase program. This result is related to Almeida, Fos, and Krunlund (2016), who show that firms reduce employment and investment to help fund share repurchases that are motivated by earnings per share (EPS) management. The evidence in Almeida et al. (2016) does not focus on the effect of payout *inflexibility*, as we do in this article. The notion of "inflexibility" means that payout decisions today are constrained by past payout decisions, that is, firms repurchase shares because they have already announced a repurchase program and feel compelled to complete it. The driving force behind repurchases in Almeida et al. (2016) is to meet the current EPS target, rather than the previous level of repurchases or the need to complete an existing repurchase program. To the best of our knowledge, ours is the first paper to show evidence that payout inflexibility can have real consequences for firms. In particular, despite all the evidence on dividend inflexibility, there is no existing evidence that this inflexibility has real effects. In our article, we are able to use the specific setting of repurchase plans to measure the real effects of payout inflexibility on firms during the 2008 financial crisis. In addition, an advantage of our approach is that we focus on share repurchases broadly, not just those driven by EPS management, which could be fundamentally different from other repurchases, represent only a fraction of overall repurchases, and may be more relevant for

[4]Kahle and Stulz (2021) show that total dividend payout increases steadily while repurchases fluctuate in the 2000s, while Iyer and Rao (2017) document that the number of firms reducing repurchases is higher than the number of firms reducing dividends during the financial crisis. Our finding provides the potential reason of these empirical findings: Firms have more flexibility not to initiate a repurchase program (given past repurchases) than not completing a program that has been authorized. In essence, although repurchase programs can be inflexible once initiated, the option to not initiate repurchase programs affords firms some additional flexibility.

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specific types of firms.[5] The finding that firms are willing to trade off real investment for repurchases is new and surprising. Our article suggests that this trade-off holds for repurchases in general, including those that are not necessarily driven by earnings management. By showing the decline in repurchase SOA and the effect of payout inflexibility on real investments, our article provides a comprehensive and novel understanding of the (in)flexibility of repurchases and the associated real implications.

More broadly, our article contributes to the large literature on share repurchases. Many papers document the reasons why firms buy back their stocks, such as stock price undervaluation (Ikenberry, Lakonishok, and Vermaelen (1995), Brockman, and Chung (2001), and Peyer and Vermaelen (2009)), to mitigate agency problems by returning excess cash to investors when investment opportunities are low (Dittmar (2000), Grullon and Michaely (2004)), and employee stock option exercise anti-dilution (Kahle (2002)).[6] Fewer researchers examine the completion of open market share repurchase programs. Stephens and Weisbach (1998) find that firms increase their share repurchases when the degree of perceived undervaluation is higher. Oded (2009) finds that the wider the bid–ask spread, the lower the share repurchase completion rate.[7] Bonaimé (2012) and Yamaguchi (2021) show that firms have higher announcement returns of new share repurchase programs if they have completed their prior programs, and Bargeron, Bonaimé, Docimo, Feng, and Thomas (2024) provide evidence that investors punish firms for suspending programs. These findings help justify why firms seek to complete existing share repurchase programs.

The rest of the article is organized as follows: In Section II, we discuss the empirical strategy and sample selection. Section III presents the SOA analysis, and Section IV studies the effect of share repurchase programs on firms' real activities. We conclude in Section V.

II. Empirical Design and Data

In this section, we begin by providing institutional details on open market share repurchase programs. We then explain the empirical specification for calculating the SOA for share repurchases and the identification strategy using program ending dates around the 2008 financial crisis. Lastly, we describe our sample selection process and construction of variables and present the summary statistics.

A. Open Market Share Repurchase Programs

Open market share repurchase programs are becoming increasingly popular among U.S. firms. By 2013, over 40% of U.S. publicly traded firms had initiated open market share repurchase programs, more than threefold the 1995 figure (Skinner (2008)).

[5]Almeida et al. (2016) show that EPS-driven repurchases are more likely when compensation contracts depend explicitly on EPS.

[6]The list here is not exhaustive. See Farre-Mensa et al. (2014) for a review of the literature.

[7]Li, Ye, and Zheng (2024) also find evidence that microstructure frictions are an important driver of share repurchases.

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After the board of directors' approval, firms usually make public announcements about their open market share repurchase programs. In the announcements, firms disclose the total dollar amount and/or total number of shares to repurchase. Those two numbers are generally fixed values instead of ranges. Firms on average have open market share repurchase programs as large as 7% of their total number of shares outstanding (Stephens and Weisbach (1998)). In the announcements, firms also inform investors about the time frame of their open market share repurchase programs, usually with specific ending dates. Some firms choose the announcement day as the starting date, while others announce a specific future date as the inception date.[8] The announcements often have disclaimers stating that the managers have the flexibility to decide when and how much to repurchase given market conditions throughout the programs. When the managers decide to repurchase shares, they hire a broker-dealer to repurchase shares on their behalf on the open market. The time period between the ending of one program and the starting of the next is usually about 2 years (Skinner (2008)). As examples, the following two paragraphs are excerpts from General Motors Co. and Apple Inc.'s announcements of open market share repurchase programs, respectively:

> General Motors Co. (NYSE: GM) today announced a comprehensive capital allocation framework, as improving business performance and strong capital discipline enable increased returns to shareholders. GM said a foundational element of its approach will be to return all available free cash flow to shareholders while it maintains an investment-grade balance sheet underpinned by a target cash balance of $20 billion … GM also announced that its Board of Directors authorized the initial repurchase of $5 billion in GM shares to begin immediately and conclude before the end of 2016… (May 9, 2015)

> Apple today announced plans to initiate a dividend and share repurchase program commencing later this year … Additionally, the Company's Board of Directors has authorized a $10 billion share repurchase program commencing in the Company's fiscal 2013, which begins on Sept. 30, 2012. The repurchase program is expected to be executed over 3 years, with the primary objective of neutralizing the impact of dilution from future employee equity grants and employee stock purchase programs… (Mar. 19, 2012)

B. SOA

In his seminal paper, Lintner (1956) shows that firms set their dividend policy as a function of the SOA of current dividends and the targeted payout ratio. Lintner also assumes that the target dividend is a fixed fraction of earnings. Lintner's (1956) empirical model is

$$(1) \qquad \textit{Change in dividend}_{i,t} = \alpha_i + c_i \times \left(r_i \times \textit{Earnings}_{i,t} - \textit{Dividend}_{i,t-1}\right) + \varepsilon_{i,t}.$$

[8] On announcement day, investors usually observe a 2%–4% abnormal stock return (Lie (2005)) as a positive signal from the market.

where r_i is a firm's target dividend payout ratio; $r_i \times Earnings_{i,t}$ represents the amount of dividend that would have been paid in the current year if the firm applies its fixed target dividend payout ratio r_i to current profits; and $(r_i \times Earnings - Dividend_{i,t-1})$ is then the difference between the target dividend in year t and the actual dividend paid in the preceding year $t-1$. The parameter c_i is often referred to as the SOA. Smaller values of c_i suggest that firms' dividend policies are less sensitive to transitory earnings shocks. This equation can also be written as

$$(2)\quad Change\,in\,dividend_{i,t} = \alpha_i + c_i \times r_i \times Earnings_{i,t} + (-c_i) \times Dividend_{i,t-1} + \varepsilon_{i,t}.$$

Thus, smaller values of c_i indicate that lagged dividends contain more predictive power for current dividends (i.e., dividends are sticky over time).

In practice, to study the stickiness of firms' dividend policies, we can rewrite equation (2) as

$$(3)\quad Change\,in\,dividend_{i,t} = \alpha_i + \beta_i \times Dividend_{i,t-1} + \theta_i \times Earnings_{i,t} + \varepsilon_{i,t}.$$

In equation (3), the change in firm i's dividend in year t is regressed on its dividend in year $t-1$ and earnings in year t. The coefficient β_i in equation (3) corresponds to $-c_i$ in equation (2). Thus, $-\beta_i$ represents the estimated SOA (see, e.g., Grullon and Michaely (2004), Brav et al. (2005), and Michaely and Roberts (2012)).

Given the increasing popularity of share repurchase programs, we formally test whether firms set share repurchase policies to transitory earnings shocks in the spirit of the Lintner (1956) model. Specifically, we rewrite equation (2) with share repurchases instead of dividends, that is,

$$(4)\quad Change\,in\,repurchase_{i,t} = \alpha_i + c_i \times Target\,repurchase_{i,t} + (-c_i) \times Repurchase_{i,t-1} + \varepsilon_{i,t}.$$

Estimating this equation requires an implicit model for target repurchases.[9] For comparison with the original Lintner model, we use earnings to predict target repurchases in some specifications, but we also incorporate various other variables that may affect share repurchases in other specifications including cash, Q, firm size, and leverage. For example, if target repurchases are only a function of earnings, we estimate

$$(5)\quad Change\,in\,repurchase_{i,t} = \alpha_i + \beta_i \times Repurchase_{i,t-1} + \theta_i \times Earnings_{i,t} + \varepsilon_{i,t}.$$

Therefore, $-\beta_i$ represents the SOA of share repurchase programs, with smaller values of $-\beta_i$ indicating a more persistent share repurchase policy.

C. Estimating the Trade-Off Between Repurchases and Investments

In this subsection, we introduce our empirical methodology for estimating the real effects of share repurchase programs. We begin by describing a setting that provides a shock to firms' ability to raise capital – the 2008 financial crisis. We then outline the identification strategy and the assignment of treated and control firms.

[9]The term r_i, target payout ratio, is omitted here because *target repurchase* already incorporates this parameter.

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1. The 2008 Financial Crisis

The 2008 financial crisis is widely regarded as a supply shock in the academic literature. During this period, firms had a hard time accessing external financing. Almeida et al. (2012) document a dramatic credit spread increase for both short- and long-term credit instruments. Ivashina and Scharfstein (2010) find that bank lending falls in all types of loans. Gorton (2009) theoretically models that banks are flying to quality, which leads to the increased cost of all forms of external capital (Caballero and Krishnamurthy (2008)). The literature generally finds that firms that were more financially constrained coming into the crisis were forced to cut real investments and employment during the crisis (Duchin et al. (2010), Almeida et al. (2012), and Giroud and Mueller (2016)).[10] Consistent with these papers, we choose Dec. 2007 as the cutoff date used in our identification strategy.

2. Identification Strategy

In the spirit of Almeida et al. (2012) and Ouimet and Simintzi (2021), we treat share repurchase programs as contracts that are negotiated and signed ahead of time. Similar to firms' debt maturities that are predetermined with a specific due date as in Almeida et al. (2012) and the labor contracts that are signed at random times but require renewal at a specific future date as in Ouimet and Simintzi (2021), open market share repurchase programs are announced ahead of time for a fixed length of time with the predetermined program ending dates. Therefore, managers do not strategically set the ending dates of their open market share repurchase programs ex ante.

To be in our sample, we require firms to have announced open market share repurchase programs in the 3 years prior to Dec. 2007. We then assign our sample firms to the treated and control groups based on the ending dates of their open market share repurchase programs. Firms with open market share repurchase programs ending after Dec. 2007 are assigned to the treated group, while firms with repurchase programs ending in or before Dec. 2007 are assigned to the control group.[11] Firms in the control group just happened to have finished their repurchases before 2008. Skinner (2008) finds that firms announce new share repurchase programs every other year; similarly, the announcement gap in our sample is around 2.4 years. Since firms generally do not have share repurchase programs one immediately after another, the control group is very likely to be in the gap period. Managers could then decide not to announce new programs (e.g., they can adjust repurchases to a new target that takes into consideration the financial crisis).

[10]Farre-Mensa, Michaely, and Schmalz (2025) find that 43% of the firms that engage in payout activities also raise external capital to fund for those payouts simultaneously. The popular press also has numerous articles about firms issuing debt to fund share repurchases. For example, see a recent article on Johnson & Johnson in the *Wall Street Journal* ("A $10 Billion Buyback Doesn't Kill Johnson & Johnson's Deal Hopes," retrieved at https://www.wsj.com/articles/a-10-billion-buyback-doesnt-kill-johnson-johnsons-deal-hopes-1444761114 on Oct. 15, 2015).

[11]Since open market share repurchases are flexible, managers may have the ability to adjust the ending dates once they anticipate an impending financial crisis. However, Bargeron, Bonaimé, and Thomas (2017), who hand-collect data on firms' announcements regarding changes to their open market share repurchase programs from news sources for the 1980–2010 period, find that only 2% of firms make such adjustments. Therefore, it is unlikely that our results are influenced by this small set of firms.

One potential concern with this identification strategy is that firms in the treated group might have already completed their repurchase programs near the cutoff date. If so, our identification strategy will not capture the true outstanding repurchase amount and the associated funding needs at the treated firms. To address this issue, we hand-collect the treated group's share repurchase program status around Dec. 2007 from their closest 10-K or 10-*Q* reports. We find that the treated group, on average, only repurchased about 35% of the predetermined amounts of shares as well as dollars.[12] This exercise mitigates the concerns that the firms tried to accelerate their share repurchases before the financial crisis and had only a small fraction of repurchases not yet completed. Our identification strategy thus allows us to gauge the effects of open market share repurchase programs by comparing outcomes at the treated and the control firms.

3. Matching Treated and Control Firms

Our goal is to test whether the treated firms behave differently compared to the control firms. One plausible approach is to compare the differences between potential counterfactual outcomes to those that are observed in the data. One could run a parametric regression in which the treated group is differentiated from all other observations with a dummy variable. The regression coefficient on the dummy variable would measure the estimated differences. Such a model is often specified based on theoretical priors with control variables added to capture firm-level heterogeneity. However, the treated and control groups may still differ significantly in their characteristics despite the inclusion of controls, as control variables may have poor distributional overlap (Heckman, Ichimura, Smith, and Todd (1998). One way to improve the estimation is to match treated and control firms on the observables.

For each observation in the treated group (i.e., firms with share repurchase programs ending after the financial crisis), we look for a control observation that best matches it based on a host of covariates. The matched control observations would serve as the counterfactual to the treated group in the estimation. The assumption is that the treated group would behave similarly to the control group in the absence of the treatment. We conduct the matching procedure to ensure that the treated and control groups have similar distributions across all selected covariates.

We implement the nearest neighbor matching between a vector of observed covariates to pair treated and control firms. In our estimation, we match firms based on firm size, *Q*, leverage, cash holdings, cash flow, and industry (based on the 4-digit SIC code), using the averages before Dec. 2007. We also include the size of the share repurchase program as a criterion for matching to ensure that our results are not driven by different program sizes between the treated and control groups. The treated and control firms should differ only on the timing of their programs.

[12]We find that as of Dec. 2007, an average of 355 days had elapsed for the treated firms' repurchase programs, which had an average duration of 1,300 days. Thus, these firms were roughly a quarter of the way through their share repurchase programs as of Dec. 2007. Meanwhile, approximately two-thirds of the shares (by dollar amount) remained unrepurchased. This evidence shows that the treatment group was on track with but had not yet completed their share repurchases.

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D. Sample Selection, Construction of Variables, and Summary Statistics

The data used in this article come from two sources. We use the SDC Mergers and Acquisitions database for information on open market share repurchase deals, including announcement date, completion date, number of shares (dollar value) authorized, and number of shares (dollar value) repurchased. The SDC data do not provide comprehensive coverage of all firms that announce share repurchase programs (Banyi, Dyl, and Kahle (2008)). We supplement the SDC data by searching for additional share repurchase programs in firms' annual reports, other Securities and Exchange Commission (SEC) filings (such as 8-Ks), and financial news outlets. We require the share repurchase programs to be open market share repurchase programs only. We also hand-check the accuracy of the SDC data to address potential concerns of double counting some programs, inaccurate categorization of program amendments, and erroneous or missing program beginning and ending dates.[13] We eliminate program announcements for which we cannot find the beginning or ending dates. We complement the SDC data with data from Compustat to measure firm-level outcomes and firm characteristics. We exclude all firms in the financial services and utilities industries (SIC codes 4900–4000 and 6000–6999, respectively). For the financial crisis tests, we define the precrisis period as from 2005 to 2007 and the postcrisis period as from 2008 to 2010.

For the SOA analysis, the main variables of interest are change in share repurchase, lagged share repurchase, change in dividend, and lagged dividend. Following Dittmar (2000), Jagannathan, Stephens, and Weisbach (2000), and Grullon and Michaely (2002), share repurchase is the total expenditure on the purchase of common and preferred stocks minus the reduction in value in preferred stocks. We set share repurchase to equal 0 for firms that do not repurchase at least 1% of their market value of equity. Change in share repurchase is the difference in share repurchase scaled by total assets from year $t - 1$ to year t. Lagged share repurchase is share repurchase scaled by total assets in year $t - 1$. Change in dividend is the difference in dividend per share from year $t - 1$ to year t. The lagged dividend is dividend per share in year $t - 1$.

We measure firms' real activities using three variables, namely investment, employment, and R&D expense. Investment is defined as capital expenditures scaled by lagged total assets. Employment is defined as the natural logarithm of the number of employees per million dollars of lagged total assets. R&D expense is defined as the total research and development expense scaled by lagged total assets. In terms of control variables and matching covariates, we include firm size, Q, leverage, cash holdings, cash flow, earnings, and the size of the share repurchase programs. Size is the natural logarithm of total assets. Q is the book value of assets plus the market value of equity minus total debt and deferred taxes all over lagged assets. Leverage is defined as the sum of long-term debt and debt in current liabilities all over lagged assets. Cash flow is the sum of income before extraordinary items and depreciation and amortization scaled by lagged total assets. Cash

[13] In our cleaning of the SDC data, we first consider the "initial authorization date" as the program beginning date. If the "initial authorization date" is missing but the "latest authorization date" is not missing, we replace the former with the latter.

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holding is cash and short-term investments scaled by lagged total assets. Earnings is income before extraordinary items scaled by lagged total assets in the share repurchase sample and scaled by the number of shares outstanding in the dividend sample. The size of the share repurchase programs is the dollar amount of share repurchase programs scaled by lagged total assets. In addition, for the postcrisis years, the values of our firm-level controls are fixed at their respective levels at the end of the year 2007 to mitigate endogeneity concerns. Our results are robust to using controls at their postcrisis-year values.

Table 1 presents the summary statistics. For each variable, we present the sample size, mean, standard deviation, 25th percentile, 50th percentile, and 75th percentile values. All continuous variables are winsorized at the top and bottom 1 percentile to minimize the impact of extreme outliers. Panels A through D report summary statistics for the share repurchase sample from 1980 to 1989, 1990 to 1999, 2000 to 2009, and 2010 to 2019, respectively. For each sample, we require the firms to repurchase shares in at least 4 years. In Panels E through H, we report summary statistics for the dividend sample by decade as well. Similarly, we require the firms to pay dividends in at least 4 years.[14] Over the last 40 years, we have seen an increasing number of firms starting to repurchase shares and a decreasing number of firms paying dividends.

III. SOA

In this section, we first carry out the SOA analysis of share repurchases. We also present the results for dividends. We then document the cross-sectional determinants of share repurchase SOA. Lastly, we study the effect of share repurchase programs on the SOA.

A. Share Repurchase SOA

In this subsection, we provide a detailed analysis of firms' policies toward changing share repurchases. Following Skinner (2008) and von Eije and Megginson (2008), we first run ordinary least squares (OLS) regressions based on equation (5). We conduct separate tests for each decade, aiming to see the trend in share repurchase policies over time. We present the estimation results in Table 2. Columns 1, 3, 5, and 7 correspond to the years 1980 to 1989, 1990 to 1999, 2000 to 2009, and 2010 to 2019, respectively. In these columns, we control only for earnings, corresponding to a model in which target share repurchases are solely determined by earnings. We see very flexible share repurchase policies in the 1980s: Firms close 79% of the gap between the desired and the current share repurchase levels within 1 year. In contrast, in the 2010s, firms' share repurchase policies have become stickier than in the earlier periods, closing 53% of the gap in

[14]We impose this filter to both the repurchase and dividend analysis following the prior literature. For example, Leary and Michaely (2011) require firm to repurchase shares 10 out of 21 years. Similarly, von Eije and Megginson (2008) restrict their sample to firms that repurchased at least three times in the period 1996 to 2005 when studying European firms.

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TABLE 1

Summary Statistics

Table 1 reports summary statistics. Panels A through D report summary statistics of the share repurchase sample for the years 1980 to 1989, 1990 to 1999, 2000 to 2009, and 2010 to 2019, respectively. Panels E through H report summary statistics of the dividend sample for the years 1980 to 1989, 1990 to 1999, 2000 to 2009, and 2010 to 2019, respectively. In each panel, we report the number of observations, sample mean, sample standard deviation, p25, p50, and p75. We require the firms to repurchase shares or pay dividends in at least 4 years in each sample. Size is the natural logarithm of book value of assets. *Q* is defined as the book value of assets plus the market value of equity minus total debt and deferred taxes all over assets. Leverage is defined as the sum of long-term debt and debt in current liabilities all over assets. Cash holding is cash and short-term investments scaled by total assets. Earnings is income before extraordinary items scaled by total assets in the share repurchase sample and scaled by the number of shares outstanding in the dividend sample. Change in share repurchase is the difference in share repurchase scaled by total assets from year $t-1$ to year t. Lagged share repurchase is share repurchase scaled by total assets in year $t-1$. Change in dividend is the difference in dividend per share from year $t-1$ to year t. Lagged dividend is dividend per share in year $t-1$. All continuous variables are winsorized at the top and bottom 1 percentile.

	N	Mean	Std. Dev.	P25	P50	P75
	1	2	3	4	5	6
Panel A. Repurchase Sample 1980–1989						
Size	4,665	5.452	2.136	3.838	5.288	7.038
Q	4,665	1.450	1.059	0.811	1.200	1.751
Leverage	4,665	0.270	0.231	0.102	0.226	0.371
Cash holdings	4,665	0.134	0.156	0.029	0.076	0.182
Earnings	4,665	0.052	0.071	0.024	0.056	0.088
Change in share repurchase	4,665	0.002	0.050	−0.007	0	0.011
Lagged share repurchase	4,665	0.020	0.038	0	0.003	0.022
Panel B. Repurchase Sample 1990–1999						
Size	7,037	5.778	2.033	4.303	5.741	7.240
Q	7,037	2.018	1.652	1.028	1.585	2.429
Leverage	7,037	0.236	0.223	0.057	0.196	0.344
Cash holdings	7,037	0.147	0.190	0.020	0.067	0.201
Earnings	7,037	0.058	0.078	0.024	0.060	0.099
Change in share repurchase	7,037	0.003	0.053	−0.009	0	0.015
Lagged share repurchase	7,037	0.027	0.046	0	0.006	0.033
Panel C. Repurchase Sample 2000–2009						
Size	9,458	6.741	2.111	5.223	6.678	8.181
Q	9,458	2.311	1.990	1.098	1.770	2.805
Leverage	9,458	0.211	0.217	0.014	0.171	0.320
Cash holdings	9,458	0.191	0.217	0.036	0.107	0.273
Earnings	9,458	0.053	0.099	0.023	0.059	0.101
Change in share repurchase	9,458	−0.001	0.074	−0.017	0	0.018
Lagged share repurchase	9,458	0.044	0.072	0	0.015	0.058
Panel D. Repurchase Sample 2010–2019						
Size	10,212	7.380	1.899	6.141	7.396	8.668
Q	10,212	2.146	1.650	1.111	1.690	2.581
Leverage	10,212	0.268	0.247	0.069	0.227	0.387
Cash holdings	10,212	0.176	0.182	0.047	0.115	0.241
Earnings	10,212	0.058	0.083	0.026	0.056	0.095
Change in share repurchase	10,212	0.003	0.061	−0.014	0	0.019
Lagged share repurchase	10,212	0.043	0.064	0	0.020	0.058
Panel E. Dividend Sample 1980–1989						
Size	21,108	5.513	1.928	4.171	5.404	6.810
Q	21,108	1.496	1.190	0.780	1.186	1.827
Leverage	21,108	0.288	0.240	0.121	0.248	0.390
Cash holdings	21,108	0.118	0.146	0.022	0.062	0.156
Earnings	21,108	1.558	2.436	0.356	1.249	2.459
Change in dividend	21,108	−0.014	0.275	−0.014	0.000	0.059
Lagged dividend	21,108	0.675	0.849	0.113	0.400	0.940
Panel F. Dividend Sample 1990–1999						
Size	20,551	5.802	2.188	4.324	5.796	7.303
Q	20,551	1.953	2.092	0.845	1.386	2.233
Leverage	20,551	0.306	0.288	0.107	0.261	0.414
Cash holdings	20,551	0.121	0.180	0.016	0.053	0.148
Earnings	20,551	0.926	1.907	0.066	0.855	1.740
Change in dividend	20,551	−0.021	0.288	−0.008	0.000	0.039
Lagged dividend	20,551	0.496	0.703	0.049	0.241	0.640

(continued on next page)

TABLE 1 (continued)
Summary Statistics

Panel G. Dividend Sample 2000–2009						
Size	19,137	6.214	2.551	4.583	6.403	7.988
Q	19,137	2.127	2.721	0.864	1.436	2.343
Leverage	19,137	0.306	0.363	0.082	0.239	0.396
Cash holdings	19,137	0.155	0.228	0.023	0.073	0.186
Earnings	19,137	0.977	2.368	−0.033	0.809	1.888
Change in dividend	19,137	0.015	0.438	−0.002	0.000	0.056
Lagged dividend	19,137	0.494	0.757	0.019	0.229	0.633
Panel H. Dividend Sample 2010–2019						
Size	17,775	6.928	2.407	5.488	7.120	8.603
Q	17,775	1.946	1.837	0.939	1.464	2.279
Leverage	17,775	0.305	0.293	0.103	0.252	0.416
Cash holdings	17,775	0.147	0.179	0.032	0.086	0.188
Earnings	17,775	1.578	2.793	0.127	1.118	2.587
Change in dividend	17,775	0.039	0.528	−0.001	0.010	0.104
Lagged dividend	17,775	0.780	1.020	0.090	0.441	1.038

1 year. Comparing the regression coefficients in column 7 and column 1, we observe a significant decrease of 26% in the SOA for share repurchases.[15]

In columns 2, 4, 6, and 8, we include a host of firm-level control variables, including size, *Q*, leverage, and cash holdings, to control for observable firm-level heterogeneity. This specification corresponds to an alternative model in which the target level of repurchases depends on all these variables, in addition to earnings. We find that the regression coefficients on lagged repurchase are very similar to what we documented before. Share repurchase flexibility has clearly and steadily declined over the years.[16]

For comparison purposes, we carry out the same analysis for dividends using the same sample periods. We run OLS regressions according to equation (3). We

[15]Leary and Michaely (2011), while studying dividend SOA, discuss two concerns with estimating SOA with equation (3). One is the small sample bias in AR(1) models, and the other is that the payout ratio is a less relevant target today. Following their approach, we perform a simulation exercise to compare the share repurchase SOA estimate from equation (5) with the true SOA. We find that the parameter estimates are biased upward, with the bias decreasing as the true SOA or the number of observations per firm increases. This bias works against us finding any patterns as our focus is on the declining trend in share repurchase SOA. The lower SOA in recent decades is possibly underestimated. In addition, we follow an alternative approach proposed by Leary and Michaely (2011) to estimate SOA and find a consistent pattern that repurchase SOA decreases gradually over the 4 decades (see Table IA1 in the Supplementary Material).

[16]We have considered the potential role of two SEC rules in contributing to the decline in the repurchase SOA. The first is the use of Rule 10b5-1 preset repurchase plans (Bonaimé, Harford, and Moore (2020)). To investigate this, we perform a text search of SEC filings to identify firms mentioning such plans. In Table IA2 Panel A in the Supplementary Material, we rerun the analysis from Table 2 but exclude firms with 10b5-1 repurchase plans. The share purchase SOA remains qualitatively similar. The second rule is the 2003 modification to Rule 10b-18, which mandates enhanced disclosure of repurchase transactions (Bonaimé (2015)). When the SEC amended Rule 10b-18 in Nov. 2003, it also adopted amendments to Regulations S-K and S-B, as well as several Exchange Act forms (e.g., 10-Q,10-K, 20-F, and Form N-CSR), requiring periodic disclosure of all issuer equity repurchases. This enhanced disclosure may have increased investor scrutiny and pressure to complete announced repurchase programs. To examine this, we conduct a text search for mentions of 10b-18 share repurchase plans in SEC filings, assuming that firms referencing 10b-18 are more likely to be affected by the rule. In Table IA2 Panel B, we exclude these firms and find results consistent with those reported in Table 2.

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TABLE 2

Share Repurchase Speed of Adjustment

Table 2 reports Lintner's (1956) type of regressions of share repurchase speed of adjustment. In each regression, we regress the change in share repurchase from year $t-1$ to year t on lagged share repurchase (i.e., share repurchase in year $t-1$). In columns 1, 3, 5, and 7, we include earnings in the regression in the spirit of the Lintner model. In columns 2, 4, 6, and 8, we include additional common firm-level controls. In columns 1 and 2, we report the results for the years 1980 to 1989. In columns 3 and 4, we report the results for the years 1990 to 1999. In columns 5 and 6, we report the results for the years 2000 to 2009. In columns 7 and 8, we report the results for the years 2010 to 2019. We require the firms to repurchase shares in at least 4 years in each sample. All variables are defined in Table 1. All continuous variables are winsorized at the top and bottom 1 percentile. Robust standard errors clustered by firm are in parentheses. *** and ** denote statistical significance at the 1% and 5% levels, respectively.

	Dependent Variable: Change in Repurchase							
	1980–1989		1990–1999		2000–2009		2010–2019	
	1	2	3	4	5	6	7	8
Lagged repurchase	−0.794***	−0.793***	−0.619***	−0.620***	−0.581***	−0.585***	−0.528***	−0.533***
	(0.019)	(0.019)	(0.025)	(0.024)	(0.016)	(0.016)	(0.016)	(0.016)
Size		−0.000		−0.000		−0.001**		−0.001***
		(0.000)		(0.000)		(0.000)		(0.000)
Q		0.000		0.000		0.001		0.002***
		(0.001)		(0.001)		(0.001)		(0.001)
Leverage		−0.006**		−0.012***		−0.019***		−0.009***
		(0.003)		(0.003)		(0.004)		(0.003)
Cash holdings		−0.005		−0.010**		−0.006		−0.007
		(0.005)		(0.004)		(0.004)		(0.005)
Earnings	0.071***	0.069***	0.133***	0.127***	0.140***	0.133***	0.173***	0.164***
	(0.011)	(0.013)	(0.011)	(0.012)	(0.010)	(0.010)	(0.010)	(0.011)
Constant	0.014***	0.018***	0.012***	0.018***	0.018***	0.026***	0.015***	0.025***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.003)
Observations	4,665	4,665	7,037	7,037	9,458	9,458	10,212	10,212
Adjusted R^2	0.362	0.363	0.287	0.289	0.312	0.316	0.274	0.278

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TABLE 3

Dividend Speed of Adjustment

Table 3 reports Lintner's (1956) type of regressions of dividend speed of adjustment. In each regression, we regress the change in dividend from year $t-1$ to year t on lagged dividend (i.e., dividend in year $t-1$). In columns 1, 3, 5, and 7, we include earnings in the regression in the spirit of the Lintner model. In columns 2, 4, 6, and 8, we include additional common firm-level controls. In columns 1 and 2, we report the results for the years 1980 to 1989. In columns 3 and 4, we report the results for the years 1990 to 1999. In columns 5 and 6, we report the results for the years 2000 to 2009. In columns 7 and 8, we report the results for the years 2010 to 2019. We require the firms to pay dividends in at least 4 years in each sample. All variables are defined in Table 1. All continuous variables are winsorized at the top and bottom 1 percentile. Robust standard errors clustered by firm are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: Change in Dividend							
	1980–1989		1990–1999		2000–2009		2010–2019	
	1	2	3	4	5	6	7	8
Lagged dividend	−0.155***	−0.167***	−0.201***	−0.216***	−0.214***	−0.224***	−0.194***	−0.203***
	(0.006)	(0.008)	(0.008)	(0.009)	(0.011)	(0.012)	(0.011)	(0.011)
Size		0.010***		0.014***		0.013***		0.016***
		(0.002)		(0.001)		(0.001)		(0.002)
Q		−0.016***		−0.005***		0.001		0.012***
		(0.002)		(0.001)		(0.001)		(0.003)
Leverage		−0.008		−0.000		0.020**		0.027*
		(0.009)		(0.008)		(0.010)		(0.014)
Cash holdings		0.035**		0.047***		−0.003		−0.048*
		(0.014)		(0.012)		(0.016)		(0.028)
Earnings	0.050***	0.050***	0.038***	0.035***	0.040***	0.037***	0.060***	0.056***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	0.012***	−0.013	0.044***	−0.022***	0.081***	0.002	0.096***	−0.022
	(0.004)	(0.008)	(0.003)	(0.006)	(0.005)	(0.008)	(0.007)	(0.016)
Observations	21,108	21,108	20,551	20,551	19,137	19,137	17,775	17,775
Adjusted R^2	0.204	0.212	0.208	0.218	0.139	0.144	0.141	0.146

present the results in Table 3. Columns 1, 3, 5, and 7 show the results using the original Lintner (1956) model and correspond to the years 1980 to 1989, 1990 to 1999, 2000 to 2009, and 2010 to 2019, respectively. In columns 2, 4, 6, and 8, we again include the same firm-level controls, which allow the target dividend to depend on these additional covariates. We find the SOA to be stable across all specifications and time periods, ranging from 16% to 22%. Taking column 8 as an example, firms, on average, close 20% of the gap between desired and current dividend levels in 1 year. The results are in line with those reported in earlier studies that firms' dividend policies are fairly sticky.[17]

Taken together, we observe that the SOA for firms' share repurchases declines significantly over time, but it remains higher than the SOA of dividends. Our results show that although share repurchases continue to be the more flexible option to return capital to investors, firms' share repurchases have become increasingly sticky over the past 4 decades.

[17]In Tables IA3 and IA4 in the Supplementary Material, we remove the requirements that firms must have repurchased shares or paid dividends in at least 4 years in each sample, respectively. We continue to observe the same pattern (i.e., dividend SOA remains stable over the 4 decades while repurchase SOA decreases gradually).

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B. Cross-Sectional Determinants of Share Repurchase Program SOA

Next, we explore the cross-sectional determinants of the share repurchase program SOA to document what types of firms smooth share repurchases more or less. We first follow equation (5) to estimate the SOA for each firm over our entire sample period (1980–2019), again requiring the firms to repurchase shares in at least 4 years, and we retain only nonnegative SOAs. We then calculate the median of each firm characteristic, following measures used in the prior literature (e.g., Leary and Michaely (2011)). In Table 4, we examine the cross-sectional determinants of the repurchase SOA by regressing firm-level SOA on firm characteristics.

In column 1, we include Q and cash holdings as independent variables. Firms with higher growth opportunities have lower SOA, indicating a greater tendency to smooth share repurchases, while firms with more cash are less likely to do so. In column 2, we add profitability and volatility of earnings to the regression. More

TABLE 4

Cross-Sectional Determinants of Share Repurchase SOA

Table 4 reports the cross-sectional determinants of share repurchase SOA. The sample period is from 1980 to 2019. The dependent variable, share repurchase SOA, is estimated based on equation (5) (i.e., $-\beta_1$) for each firm. The independent variables are the median firm characteristics over the sample period. Q is defined as the book value of assets plus the market value of equity minus total debt and deferred taxes all over assets. Cash holding is cash and short-term investments scaled by total assets. sd(EBITDA) is the standard deviation of EBITDA. Cash flow is the sum of income before extraordinary items and depreciation and amortization scaled by total assets. Tangibility is property, plant, and equipment scaled by total assets. Leverage is defined as the sum of long-term debt and debt in current liabilities all over assets. Size is the natural logarithm of book value of assets. Dividend payout ratio is the total dividend over net income. Institutional (Inst.) ownership is the fraction of shares held by institutions from 13F filings. # of analysts is the number of analysts covering the firm from IBES. All continuous variables are winsorized at the top and bottom 1 percentile. We require the firms to repurchase shares in at least 4 years in each sample and retain only nonnegative SOAs. Robust standard errors clustered by firm are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: SOA				
	1	2	3	4	5
Q	−0.047***	−0.051***	−0.046***	−0.045***	−0.040***
	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
Cash holdings	0.018**	0.016**	0.016**	0.019**	0.018**
	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
sd(EBITDA)		−0.048***	−0.020***	−0.021***	−0.026***
		(0.005)	(0.006)	(0.006)	(0.007)
Cash flow		0.013*	0.020***	0.017**	0.018**
		(0.007)	(0.007)	(0.007)	(0.007)
Tangibility			0.005	0.004	0.003
			(0.007)	(0.007)	(0.007)
Leverage			0.023***	0.026***	0.026***
			(0.008)	(0.008)	(0.008)
Size			−0.058***	−0.064***	−0.050***
			(0.007)	(0.008)	(0.009)
Div. payout ratio				0.019***	0.014**
				(0.006)	(0.006)
Inst. ownership					−0.018**
					(0.008)
# of analysts					−0.002
					(0.008)
Constant	0.806***	0.806***	0.806***	0.806***	0.806***
	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	2,879	2,879	2,879	2,879	2,879
Adjusted R^2	0.017	0.042	0.064	0.067	0.069

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profitable firms and firms with lower earnings volatility are less likely to smooth repurchases. We next include measures for asset tangibility, leverage, and size to the regression in column 3. Firms with higher leverage are less likely to smooth, while larger firms are more likely to engage in smoothing. In column 4, we further add the dividend payout ratio to examine the potential substitution between dividends and share repurchases. We find that firms that pay more dividends are less likely to smooth share repurchases. In column 5, we additionally include two measures of monitoring: institutional ownership and the number of analysts covering the firm. We find weak evidence that firms with higher institutional holdings are more likely to smooth share repurchases.[18]

C. Flexibility Within and Across Share Repurchase Programs

Previous research has shown that firms tend to complete repurchase programs once they are announced (Stephens and Weisbach (1998)). It is therefore natural to expect that once a repurchase program is announced, managers may feel pressured to maintain a certain level of actual repurchases for the duration of the program. This argument suggests that flexibility may decrease once a share repurchase program is announced.

To test whether this is the case, we identify firm-years with share repurchase programs in place. Specifically, we create a dummy variable that equals 1 if the firm has a repurchase program in place in year *t*. We interact this dummy variable with lagged share repurchase to capture the effect of having share repurchase programs on share repurchase policies. We also include the same firm-level controls as in Table 2. We modify equation (5) as

$$\begin{aligned}(6)\quad Change\,in\ repurchase_{i,t} = {} & \alpha_i + \beta_{1i} \times Repurchase_{i,t-1} + \beta_{2i} \\ & \times program\ dummy_{i,t} + \beta_{3i} \times Repurchase_{i,t-1} \\ & \times program\ dummy_{i,t} + \varepsilon_{i,t}.\end{aligned}$$

We run OLS regression based on equation (6) by decade and present the results in Table 5. Adding the coefficients on lagged repurchase and on the interaction term gives us the SOA for firms with share repurchase programs in place. For the years 1980 to 1989, the coefficient on the interaction term is positive but not statistically significant. For the next 3 decades, the coefficients on the interaction term are positive and statistically significant at the 1% level. The SOA for firms with repurchase programs is approximately 55% during the 1990s, 47% during the 2000s, and 29% during the 2010s, all significantly lower than the SOA for firms without repurchase

[18]In Table IA5 in the Supplementary Material, we report the cross-sectional determinants of dividend SOA for comparison. Firms with lower cash holdings, higher earnings volatility, lower leverage, lower dividend payout ratio, and higher institutional holdings have lower SOA for both dividends and share repurchases, indicating a greater tendency to smooth both. In contrast to the findings on dividend SOA determinants, firms with high growth potential and low cash flow are more likely to smooth repurchases. For these firms, repurchase smoothing may be more important due to signaling benefits. A related reason could be that these firms prioritize building their cash reserves, opting to save rather than distribute excess free cash flow while maintaining steady repurchase levels. It is worth noting that an important selection effect likely underlies the comparison of dividend and repurchase SOAs, as firms that pay dividends and those that repurchase shares may differ in meaningful ways.

TABLE 5

Share Repurchase Speed of Adjustment with Repurchase Programs in Place

Table 5 reports Lintner's (1956) type of regressions of share repurchase speed of adjustment. In each regression, we regress the change in share repurchase from year $t-1$ to year t on lagged share repurchase (i.e., share repurchase in year $t-1$), an indicator for whether the firm has a repurchase program in place, and the interaction term. In columns 1 to 4, we report the results for the years 1980 to 1989, 1990 to 1999, 2000 to 2009, and 2010 to 2019, respectively. We require the firms to repurchase shares in at least 4 years in each sample. All variables are defined in Table 1. All continuous variables are winsorized at the top and bottom 1 percentile. Robust standard errors clustered by firm are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: Change in Repurchase			
	1980–1989	1990–1999	2000–2009	2010–2019
	1	2	3	4
Lagged repurchase	−0.807***	−0.698***	−0.665***	−0.608***
	(0.018)	(0.026)	(0.015)	(0.015)
Program dummy	0.014	0.013***	0.004**	0.005**
	(0.012)	(0.002)	(0.002)	(0.002)
Lagged repurchase × program dummy	0.350	0.148***	0.196***	0.317***
	(0.391)	(0.046)	(0.041)	(0.040)
Size	−0.000	−0.001**	−0.001**	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Q	−0.000	0.000	0.001	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Leverage	−0.006**	−0.010***	−0.018***	−0.007**
	(0.003)	(0.003)	(0.004)	(0.003)
Cash holdings	−0.005	−0.006	−0.003	−0.004
	(0.005)	(0.004)	(0.004)	(0.005)
Earnings	0.069***	0.118***	0.128***	0.151***
	(0.013)	(0.012)	(0.010)	(0.010)
Constant	0.019***	0.017***	0.024***	0.025***
	(0.002)	(0.002)	(0.003)	(0.003)
Observations	4,665	7,037	9,458	10,212
Adjusted R^2	0.369	0.313	0.333	0.313

programs in place. Taking the years 2010 to 2019 as an example, the overall average SOA is 53% for all firms in the sample (Table 2 column 8), whereas firms with share repurchase programs in place have an average SOA of 29%.

Strikingly, for firms with repurchase programs, the estimated SOA during the 2010 decade is economically similar to the SOA estimated for dividends during the same period (which is approximately 20% in Table 3 column 8). For firms with repurchase programs in place, dividends and repurchases appear to have become almost equally (in)flexible. These results also suggest that there is more repurchase flexibility once an existing program expires: Managers can then set repurchase amounts closer to current target levels.

IV. The Trade-Off Between Share Repurchases and Real Investments

The increasing inflexibility of repurchases that we have documented so far does not necessarily imply that repurchases have real effects on other policies, such as real investments. Financially constrained firms can set repurchase programs to levels that do not compromise their ability to fund real investments. If that is the

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case, then the pressure to maintain a certain level of repurchases should not have real effects. On the other hand, the relative inflexibility of repurchases once a program is in place raises an interesting possibility: What if a firm with a repurchase program in place is hit with a significant and unexpected financial shock that undermines the firm's ability to raise capital? In that case, the firm may need to choose either abandoning the planned repurchases or maintaining the planned level of repurchases and cutting other expenditures.

In this section, we test whether firms are willing to trade off real investments for repurchases, using the 2008 financial crisis as a shock. As discussed in Section II.C, we assign our sample firms to the treated and control groups based on the ending dates of their open market share repurchase programs. Firms with open market share repurchase programs ending after Dec. 2007 are assigned to the treated group, while firms with repurchase programs ending in or before Dec. 2007 are assigned to the control group. We start by describing our matching procedure. We then show the main results, followed by robustness checks. We conclude this section with statistics on share repurchase program completion rates and additional evidence on firms' operating performance.

A. Descriptive Statistics

We report the summary statistics for our matching procedure in Table IA6 in the Supplementary Material. We match on firm size, Q, leverage, cash holdings, cash flow, the size of the share repurchase programs, and industry (based on the 4-digit SIC code), using the averages before Dec. 2007. Since our matching approach is nonparametric, our results are less susceptible to extreme observations. To minimize the impact of extreme outliers, we winsorize all continuous variables at the top and bottom 1 percentile. For each matching covariate, we report the respective mean for the treated and control groups, as well as the difference in mean and its statistical significance (t-stat and p-value). We observe no statistically significant difference in any of the matching covariates between the treated and control groups. These statistics support the assertion that the matching estimator approach ensures our treated and control groups differ only in the ending dates (i.e., the treatment) of their share repurchase programs.

B. Are Share Repurchases Really Flexible?

We examine the real activities of our treated and control firms around the 2008 financial crisis. Specifically, we compare firms with open market share repurchase programs ending after Dec. 2007 to otherwise similar firms with share repurchase programs ending in or before Dec. 2007. We run OLS regressions of the following form using our matched sample:

$$(7)\quad y_{i,t} = \beta_1 \times Treat_{i,t} + \beta_2 \times Post_{i,t} + \beta_3 \times Treat_{i,t} \times post_{i,t} + \delta \times X_{i,t} + \theta_i + \tau_t + \varepsilon_{i,t}.$$

In equation (7), i and t index firm and year, respectively. $y_{i,t}$ represent the outcome variables, including investment, employment, and R&D expenses. $Treat_{i,t}$ equals 1 if firm i has an open market share repurchase program ending after Dec. 2007. $Post_{i,t}$ equals 1 if firm i is in the years 2008 to 2010. $X_{i,t}$ is a set of time-

TABLE 6

Are Open Market Share Repurchase Programs Really Flexible?
Evidence from Firms' Real Activities

Table 6 reports the effects of having open market share repurchase programs ending after Dec. 2007 on firms' real activities. The sample is from 2005 to 2010. The treated firms are defined as those with share repurchase programs ending after Dec. 2007. The control firms are defined as those with share repurchase programs ending in or before Dec. 2007. We match firms in the treated and control groups based on firm size, *Q*, leverage, cash holdings, cash flow, repurchase program size, and industry. The dependent variables are investment, employment, and R&D expense in columns 1–2, 3–4, and 5–6, respectively, all scaled by total assets. All variables are defined in Table IA7. All continuous variables are winsorized at the top and bottom 1 percentile. Robust standard errors clustered by firm are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Investment	Investment	Employment	Employment	R&D Expense	R&D Expense
	1	2	3	4	5	6
Treat	Absorbed by firm FE	Absorbed by firm FE	Absorbed by firm FE	Absorbed by firm FE	Absorbed by firm FE	Absorbed by firm FE
Post	Absorbed by year FE	Absorbed by year FE	Absorbed by year FE	Absorbed by year FE	Absorbed by year FE	Absorbed by year FE
Treat × post	−0.013**	−0.016***	−0.613**	−0.678**	−0.013***	−0.011***
	(0.005)	(0.006)	(0.269)	(0.273)	(0.005)	(0.004)
Size		−0.001		−3.756**		−0.018
		(0.015)		(1.530)		(0.016)
Q		−0.002		0.009		0.004*
		(0.003)		(0.198)		(0.002)
Leverage		−0.007		2.944**		−0.013
		(0.017)		(1.437)		(0.013)
Cash holdings		−0.024		−0.379		−0.047***
		(0.021)		(1.274)		(0.012)
Cash flow		0.083**		0.460		0.001
		(0.039)		(1.248)		(0.019)
Program size		−0.007		−0.296		0.106
		(0.063)		(6.564)		(0.071)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,044	1,044	1,044	1,044	1,044	1,044
Adjusted R^2	0.549	0.573	0.949	0.960	0.912	0.932

varying firm-level control variables, including size, *Q*, leverage, cash holdings, cash flow, and the size of the share repurchase programs. θ_i captures firm fixed effects, τ_t captures year fixed effects, and $\varepsilon_{i,t}$ is the error term. β_3, the coefficient of the interaction term, is the focus of the analysis.[19]

Table 6 reports the main findings using the difference-in-differences regression approach depicted in equation (7). In column 1, the outcome variable is firm investment. The coefficient on the interaction term shows that the treated firms decrease investment more than the control firms by 1.3 percentage points and is statistically significant at the 5% level. This result suggests that the treated firms, on average, reduce their investment by about 27% of their precrisis levels more than the control firms do, which is economically large. In column 2, we add the covariates to the regression as control variables. We find qualitatively similar results.

In columns 3 to 4 and 5 to 6, we use the number of employees and R&D expenses as the outcome variables, respectively, to examine firms' other real

[19]Table IA7 in the Supplementary Material reports the summary statistics of the sample that we use for these regressions. We report the number of observations, sample mean, sample standard deviation, the 25th percentile, the 50th percentile, and the 75th percentile of each variable.

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activities. Similar to firm investments, we find that firms with repurchase programs ending after Dec. 2007 terminate more employees and decrease their R&D expenses more than otherwise similar firms with share repurchase programs ending in or before Dec. 2007. These results are statistically significant and economically meaningful, representing an 11% greater decline in precrisis employment and a 17% larger decrease in precrisis R&D spending.[20]

In summary, we show that firms with open market share repurchase programs ending after Dec. 2007 experience a substantial reduction in their real activities compared to firms with programs ending in or before Dec. 2007. These results suggest that firms are cutting their real activities to fund their open market share repurchase programs. The findings provide evidence that firms are willing to trade off real investments for share repurchases.

C. Robustness Tests

1. Dynamic Analysis

To properly implement a difference-in-differences estimation, we must make sure that the outcome variables of the treated and control groups follow parallel trends during the periods leading up to the 2008 financial crisis. The purpose is to make sure that the observed differences between the treated and control groups in the postevent period are driven by the treatment instead of any prior trends. We estimate a dynamic version of equation (7) by replacing $Treat_{i,t} \times post_{i,t}$ with $Treat_{i,t}$ interacted with indicators for each sample year, with 2007 being the omitted year.

We present the results of this dynamic analysis in Table 7. We report the results for investment, employment, and R&D expenses as the outcome variables in columns 1, 2, and 3, respectively. We find statistically insignificant and economically small coefficients on $Treat_{i,t} \times year2005$ and $Treat_{i,t} \times year2006$. Therefore, these findings suggest that there is no evidence that the paths of investment, employment, and R&D expense between the treated and control groups are statistically different in the years prior to the treatment.

2. Instrumental Variable (IV) Approach

Relatedly, given that our treated and control groups are defined in a binary fashion, we now consider a continuous treatment variable. Specifically, we

[20]Given that our definition of the treated and control group is binary, a firm whose repurchase program ended in Dec. 2007 should be almost as intensely treated as a firm whose repurchase program ended in Jan. 2008. A natural implication of this is that firms with a repurchase program ending late in 2008 (or in 2009) should cut investment more than a firm whose repurchase program ended in Jan. 2008. To test this implication, in Table IA8 of the Supplementary Material, we assign firms with share repurchase programs ending between Oct. 2008 and Mar. 2009 to the treated group and those with share repurchase programs ending in the first 6 months of 2008 to the control group. We find similar magnitudes as in our main results. Another potential concern is that treated firms may value financial flexibility less than firms that choose shorter (and thus inherently more flexible) repurchase programs. To address this, we also match on program duration and find qualitatively similar results, which we report in Table IA9 in the Supplementary Material.

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TABLE 7

Dynamic Analysis

Table 7 reports the effects of having open market share repurchase programs ending after Dec. 2007 on firms' real activities in a dynamic analysis. The sample is from 2005 to 2010. The treated firms are defined as those with share repurchase programs ending after Dec. 2007. The control firms are defined as those with share repurchase programs ending in or before Dec. 2007. We interact *Treat* with indicators for each sample year, with the year 2007 being the omitted year. We match firms in the treated and control groups based on firm size, *Q*, leverage, cash holdings, cash flow, repurchase program size, and industry. The dependent variables are investment, employment, and R&D expense in columns 1 to 3, respectively, all scaled by total assets. All variables are defined in Table IA7. All continuous variables are winsorized at the top and bottom 1 percentile. Robust standard errors clustered by firm are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Investment	Employment	R&D Expense
	1	2	3
Treat × year2005	0.004	−0.022	0.002
	(0.006)	(0.422)	(0.004)
Treat × year2006	0.003	0.638	0.003
	(0.007)	(0.500)	(0.004)
Treat × year2008	−0.013*	−0.586**	−0.014***
	(0.008)	(0.241)	(0.005)
Treat × year2009	−0.010	−0.333	−0.006
	(0.007)	(0.261)	(0.004)
Treat × year2010	−0.024***	−0.299	−0.008
	(0.005)	(0.313)	(0.005)
Size	−0.000	−3.705**	−0.018
	(0.015)	(1.529)	(0.016)
Q	−0.002	0.005	0.004*
	(0.003)	(0.198)	(0.002)
Leverage	−0.004	3.194**	−0.012
	(0.017)	(1.565)	(0.013)
Cash holdings	−0.024	−0.388	−0.046***
	(0.021)	(1.246)	(0.012)
Cash flow	0.086**	0.590	0.002
	(0.040)	(1.164)	(0.019)
Program size	−0.007	−0.023	0.109
	(0.063)	(6.621)	(0.071)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,044	1,044	1,044
Adjusted R^2	0.577	0.961	0.932

consider the % of repurchase programs not yet completed as of Dec. 2007, termed *not completed*, as the key independent variable. However, a potential concern with this measure is that precrisis completion rates are arguably endogenous. We instrument the completion rate with the date when the program ends (i.e., whether the firm has a repurchase program ending after Dec. 2007). The instrument satisfies the exclusion restriction. As we have argued before, the program ending dates are likely to be random relative to Dec. 2007. To show that our instrument also satisfies the relevance condition, we present the first-stage estimates in Table IA10 of the Supplementary Material. We observe a positive and statistically significant relationship between our continuous treatment variable, *not completed*, and the instrument. The first-stage *F*-statistic is 323, indicating a strong instrument.

We present the IV regression results in Table 8. Investment, employment, and R&D expense are the outcome variables in columns 1, 2, and 3, respectively. The regression coefficients on *not completed* × *post* are statistically significant and

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TABLE 8

Instrumental Variable Approach

Table 8 reports the effects of having open market share repurchase programs ending after Dec. 2007 on firms' real activities. The sample is from 2005 to 2010. The treated firms are defined as those with share repurchase programs ending after Dec. 2007. The control firms are defined as those with share repurchase programs ending in or before Dec. 2007. The key independent variable, *not completed*, is the percentage of repurchase programs not yet completed as of Dec. 2007. We instrument for *not completed* with the *treat* indicator. We match firms in the treated and control groups based on firm size, *Q*, leverage, cash holdings, cash flow, repurchase program size, and industry. The dependent variables are investment, employment, and R&D expense in columns 1 to 3, respectively, all scaled by total assets. All variables are defined in Table IA7. All continuous variables are winsorized at the top and bottom 1 percentile. Robust standard errors clustered by firm are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Investment	Employment	R&D Expense
	1	2	3
Not completed × post	−0.026***	−1.068**	−0.018***
	(0.009)	(0.434)	(0.006)
Size	−0.004	−3.869***	−0.020
	(0.015)	(1.467)	(0.016)
Q	−0.002	0.004	0.004*
	(0.003)	(0.201)	(0.002)
Leverage	−0.007	2.918**	−0.013
	(0.017)	(1.443)	(0.013)
Cash holdings	−0.024	−0.351	−0.047***
	(0.021)	(1.278)	(0.012)
Cash flow	0.085**	0.511	0.002
	(0.040)	(1.232)	(0.019)
Program size	−0.014	−0.579	0.101
	(0.064)	(6.449)	(0.068)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,044	1,044	1,044
First-stage *F*-stat	323.36	323.36	323.36

similar in magnitude to our OLS estimates. These findings provide further evidence that firms are cutting real activities to fund open market share repurchase programs.

3. Placebo Tests

Our identification strategy relies on the assumption that the treated and control groups follow parallel trends in the period leading up to Dec. 2007. We have shown that the treated and control groups have no statistical difference in the outcome variables, and the matching approach helps ensure firm characteristics are similar between the treated and control groups. To further mitigate the concern that a latent variable may be driving both the choices of open market share repurchase programs' ending time and firms' real activities, we perform placebo tests in this subsection.

Specifically, we use Dec. 2004 as a placebo event to conduct the same experiment that we did with the 2008 crisis. We use the years 2002 to 2007 for the placebo tests, among which years 2002 to 2004 constitute the before period and years 2005 to 2007 constitute the post period. Following our empirical strategy, we assign firms with open market share repurchase programs ending after Dec. 2004 to the treated group and use 2004 covariates to produce a group of control firms with open market share repurchase programs ending in or before Dec. 2004. Again, we

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require firms to have announced share repurchase programs within the 3 years leading up to the placebo event. If there is an unobservable factor driving the results, open market share repurchase programs should have effects on firms' real outcomes during the placebo period as well.

The regression results from the 2004 placebo test are shown in Table IA11 Panel A in the Supplementary Material. The dependent variables are investment, employment, and R&D expense in columns 1 to 3, respectively. Notably, we do not observe any statistically or economically significant difference between the treated and control groups during the placebo period. These findings are consistent with the argument that the results we observe are driven by having open market repurchase programs ending after the 2008 financial crisis.

So far, we have shown a consistent relation between having open market repurchase programs ending after Dec. 2007 and a reduction in real activities. However, it is possible that such effects are due to a demand shock or "macroeffect" (Almeida et al. (2012)). Specifically, firms might be more likely to cut investments during a recession, and this likelihood is higher for firms with open market repurchase programs going into recession. In order to rule out this possibility, we use a period that did not experience a credit supply shock but was a recession. Following Almeida et al. (2012), we use the 1998 to 2003 period, also known as the dotcom bubble period, during which firms experienced a recession as defined by NBER without external financing shortage.

This test is conducted in a similar way as the 2004 placebo test. Firms with open market share repurchase programs ending after Feb. 2001 are assigned to the treated group and are matched with a group of control firms with open market share repurchase programs ending in or before Feb. 2001 using the year 2000 covariates.[21] If our main findings are due to a recession, we should also see similar effects during the dotcom era. Table IA11 Panel B shows that there are no observable differences in the outcome variables between the treated and control groups during this period. These results mitigate the concern that our results are driven by demand shocks.

4. EPS-Motivated Share Repurchases

Almeida et al. (2016) document that firms cut real activities to carry out share repurchases to meet analyst EPS forecasts. We conduct two tests to rule out the possibility that this reason might drive our results. First, we exclude firms that have more than 4 EPS quarters in our 6-year sample period. Following Almeida et al. (2016), we designate a quarter an EPS quarter if the difference between the repurchase-adjusted ("prerepurchase") EPS and the median EPS forecast at the end of the quarter, scaled by the end-of-quarter stock price, is less than 0.003. The results, presented in Table IA12 in the Supplementary Material, are qualitatively similar to the main findings. Second, instead of removing firms, we include an indicator variable, *EPS year*, that equals 1 if the firm's fourth quarter is an EPS quarter to control for EPS-motivated share repurchases and present the results in

[21] We choose Feb. 28, 2001, as the cutoff for this exercise because NBER defines Mar. 2001 as the peak of the dotcom period.

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Table IA13 in the Supplementary Material.[22] The regression coefficients on $Treat_{i,t} \times post_{i,t}$ are statistically significant and of similar magnitude as those in the main results. In addition, the coefficients on *EPS year* are statistically indifferent from 0. Overall, the tests suggest that our results are not driven by EPS-motivated share repurchases.

D. Repurchase Completion Rates

So far, we have shown a decrease in real activities if the firms have open market share repurchase programs ending after the financial crisis. An important and related question is whether the freed-up liquidity from real activities indeed ends up funding the share repurchases. In Table 9, we present the share repurchase completion rates, separately for treated firms with decreases ("drop") in investment, employment, and R&D expense and those without ("no drop") between the 3 years before and after Dec. 2007. We report the percentage of shares repurchased in Panel A, calculated as the percentage of shares repurchased over the total number of shares authorized, and the percentage of dollar value repurchased in Panel B, calculated as the percentage of dollar value repurchased over the total dollar value authorized.

In columns 1 and 2, we consider firms that have experienced a "drop" and "no drop," respectively. Across both measures of repurchase completion rates and all three measures of real activities, the results confirm that firms with freed-up liquidity indeed repurchase more shares. Columns 3 and 4 present the differences in the completion rates between the two groups and the corresponding *p*-values, respectively. All the *p*-values indicate statistical significance at conventional levels.

TABLE 9

Share Repurchase Program Completion Rates

Table 9 reports share repurchase program completion rates in terms of both the percentage of shares repurchased over the total number of shares authorized (Panel A) and the percentage of dollar value repurchased over the total dollar value authorized (Panel B). We compare firms with decreases ("drop") in investment, employment, and R&D expense to those without ("no drop") between the 3 years before and after Dec. 2007. We report the mean for the "drop" and "no drop" groups in columns 1 and 2, respectively. We report the difference between the two groups in column 3 and the corresponding *p*-value in column 4. All continuous variables are winsorized at the top and bottom 1 percentile. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	"Drop"	"No Drop"	Difference	*p*-Value
	1	2	3	4
Panel A. % Shares Repurchased				
Investment	95.2%	73.4%	21.8%	0.01***
Employment	92.9%	72.4%	20.5%	0.02**
R&D expense	98.5%	81.2%	17.3%	0.02**
Panel B. % Value Repurchased				
Investment	86.5%	74.2%	12.3%	0.06*
Employment	85.9%	71.0%	14.9%	0.05**
R&D expense	92.9%	74.3%	19.7%	0.00*

[22]We follow Almeida, Ersahin, Fos, Irani, and Kronlund (2025) as the fourth-quarter earnings tend to be more influential.

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In addition, the repurchase completion rates are consistent with the repurchase schedule reported in the literature. Stephens and Weisbach (1998) back out share repurchase completion rates from dollars spent on repurchases divided by the average share price. They find that firms repurchase around 82% of the announced shares. Oded (2009) and Bonaimé (2012) find that firms complete 92% and 73% of the announced programs, respectively. Overall, our results suggest that the firms that cut back on real activities did, in fact, spend the money on open market share repurchase programs instead of diverting the funds to other activities.

E. Operating Performance

We complete the analysis by studying firms' accounting performance. Firms that cut their real activities during the crisis due to having an ongoing repurchase program might have had inferior performance in the years after the crisis. Following a similar approach as in the previous subsection, we focus on treated firms that have experienced a "drop" in investment, employment, and R&D expense between the 3 years before and after Dec. 2007. We use ROA as the outcome variable, defined as cash flow divided by lagged assets. We regress ROA on the "drop" indicators, along with firm-level controls, firm fixed effects, and year fixed effects. Firm observations for the 3 years following Dec. 2007 are included in the regression. The findings, presented in Table 10, suggest that firms indeed face subsequent adverse operating consequences as a result of scaling back on real activities.

TABLE 10

Operating Performance

Table 10 reports the effects of experiencing decreases ("drop") in investment, employment, and R&D expense between the 3 years before and after Dec. 2007 on operating performance. The sample focuses on firms with share repurchase programs ending after Dec. 2007. The dependent variable is ROA. All variables are defined in Table IA7. All continuous variables are winsorized at the top and bottom 1 percentile. Robust standard errors clustered by firm are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: ROA		
	1	2	3
"Drop" in Investment	−0.032***		
	(0.010)		
Employment		−0.025**	
		(0.013)	
R&D expense			−0.021**
			(0.010)
Size	0.005*	0.006**	0.005**
	(0.003)	(0.003)	(0.003)
Q	0.024***	0.025***	0.026***
	(0.006)	(0.005)	(0.005)
Leverage	0.034	0.041	0.038
	(0.030)	(0.030)	(0.032)
Cash holdings	−0.101***	−0.097***	−0.095***
	(0.037)	(0.037)	(0.036)
Cash flow	0.063	0.081	0.056
	(0.097)	(0.095)	(0.093)
Program size	0.044***	0.037**	0.037**
	(0.014)	(0.015)	(0.015)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	600	600	600
Adjusted R^2	0.233	0.223	0.224

V. Discussion and Concluding Remarks

Open market share repurchase programs are widely regarded as flexible tools in firms' payout policy. Firms can decide not only the timing but also the amount of buybacks. In this article, we provide evidence that open market share repurchase programs are not as flexible as one might think. The SOA for share repurchases is decreasing over time, suggesting stickier share repurchase policies over the years. In particular, firms tend to make slower changes to their share repurchase policies if they have share repurchase programs in place. For firms with repurchase programs in place, repurchases appear to be as (in)flexible as dividends.

The evidence on repurchase inflexibility suggests that it may be costly for firms to deviate from planned repurchase policies. We exploit predetermined variation in open market share repurchase program ending dates around the 2008 financial crisis to test whether repurchase inflexibility has real consequences for firms. We find that firms with repurchase programs in place indeed reduce investment, employment, and R&D spending relative to firms that face less pressure to conduct repurchases. The freed-up capital indeed goes toward the share repurchase programs as indicated by the completion rates.

Our evidence does not suggest that open market share repurchase programs are always inflexible. Repurchases are on average still more flexible than dividends. Also, we observed a 62% decrease in open market share repurchase program announcements in 2009 as a result of the financial crisis (consistent with Almeida et al. (2012) and Floyd et al. (2015)). But our evidence does suggest that once a program is announced, firms face significant pressure not to cut repurchases below the previous year's level, and that this inflexibility can even cause them to reduce real activities in order to fund program completion.

Our results have policy implications for firms. Managers can choose whether or not to announce a share repurchase program as well as its magnitude. Managers should make sure that they can complete programs before announcing them (i.e., they have enough resources to complete them or have emergency plans for unexpected events). Otherwise, firms can expose themselves to negative shocks that may force costly cutbacks in order to fund share repurchases.

Supplementary Material

To view supplementary material for this article, please visit http://doi.org/10.1017/S002210902500016X.

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