Do Stock Repurchases Cause Harm?

Evidence from buybacks by financially distressed firms.

David Ikenberry(1), Theo Vermaelen(2) and Guanqun Zhou (3)

January 2024

ABSTRACT

A growing literature argues that stock buybacks cause harm. These papers posit that buybacks divert capital from new projects otherwise beneficial to the economy and that the maneuver financially compromises firms, thus imposing financial distress costs on employees. These arguments appear to have traction; U.S. lawmakers recently imposed a 1% excise on buybacks and a proposal to quadruple the tax has been introduced. To assess whether buybacks cause harm, we focus on financially vulnerable firms who announce buybacks. If buybacks cause harm, the damage should be most evident in this sub-group. Using a total sample of 8,380 buyback announcements from 1990 to 2021, we find no evidence that buybacks harm share-holders, workers, or bondholders. Instead, managers of financially weak firms appear to ex-hibit restraint when announcing buybacks; the programs they announce are fewer in number and smaller in scale compared to buybacks in general. Further, weakened buyback firms are atypical; they tend to be more profitable than their peers and fund their buybacks through contemporary earnings rather than new debt. Contrary to the skeptics, we find no evidence of a reduction in corporate investment compared to control firms, suggesting buybacks do not displace socially desirable investment.

(1)David.Ikenberry@colorado.edu;
(2)theo.vermaelen@insead.edu;
(3)Guanqun.Zhou@colorado.edu

1. Introduction

A rich literature shows stock buybacks to be a positive tool managers can deploy to increase shareholder value. There are a variety of ways buybacks can enhance firm value. For example, buybacks may allow under-levered firms to move to a more optimal capital structure. According to the static trade-off theory of capital structure, firms trade-off the benefits from debt financing (i.e., lower corporate taxes and lower agency costs of free cash flow) against the expected cost of financial distress (Myers (1994)). The static trade-off theory assumes markets are efficient. Yet once we allow for information asymmetries (e.g., Myers and Majluf (1984)), buybacks may increase shareholder value if market prices diverge below fair value, benefitting long-term shareholders as managers repurchase undervalued stock.

Yet for all these widely held views, some academics, government officials and market pundits heavily criticize stock repurchases. High on the list of criticisms levied is that buybacks cause the firm to divert capital away from new investment projects and decreasing the financial stability of the firm. In so doing, the argument goes, buybacks deprive the firm of growth opportunities, the economy of expansion and increase bankruptcy risk which in turn imposes financial distress costs on employees.

To explain this value destruction, the argument is that managers use buybacks to benefit themselves by sending false signals to increase stock prices above fair value and then sell their personal stock at these inflated prices. Another dubious motivation for managers to buy back stock is to increase earnings per share to receive bonuses tied to earnings per share targets. Finally, as is true with any transaction increasing leverage, buybacks arguably can be used to transfer wealth from bondholders to stockholders. Such a move may be good for share prices in the short run but bad for firm value in the long run. Further, such a move may also be bad for shareholders in the long run if bondholders are punished with higher interest rates when refinancing.

These criticisms appear to have some traction with decision-makers. For example, some politicians have argued that buybacks may hamper the firm's ability to effectively compete in labor or product markets or may materially and unnecessarily expose employees to the costs associated with job dislocation when operations are suspended. Bailouts of airlines during the covid crisis were heavily criticized because airlines typically engaged in large buybacks before the crisis.[1] For these and other reasons, some politicians have argued that buybacks be more severely controlled in various ways or perhaps even eliminated.[2] In 2022 the

---

[1] See https://www.cpreview.org/blog/2021/8/when-is-enough-enough-how-covid-19-exposed-the-airline-industrys-obsession-with-stock-buy-backs

[2] See https://thehill.com/policy/finance/3590121-democrats-add-stock-buyback-tax-scrap-carried-interest-to-win-sinema-over/

Biden administration introduced a 1 % tax on buybacks and currently is calling for Congress to raise the tax to 4%.

Because it is not possible to build the counterfactual of what firms would have done had they not bought back stock, it is challenging to test the extent to which buybacks cause harm. However another way to approach the problem is to consider a subset of firms most at risk to the adverse effects of a buyback. If buybacks cause harm, the most deleterious effects of the transaction should be evident in firms already in or near financial distress. As such, we focus on buybacks announced by "zombie firms" at the time of the announcement, firms we define as in financial distress relative to other firms. Following Altman, Dai, and Wang (2021), we rely on Altman's (1968, 2018) Z-score method to ex-ante measure the likelihood for financial distress. To the extent that buybacks are harmful as critics argue, we should expect to see the most damage here.

Some argue that buyback companies divert capital away from new investment. The underlying assumption is that firms have insufficient internal resources or are unable or unwilling to issue new equity or debt. This assumption is likely unrealistic for healthy firms but may be more binding for firms in distress who may suffer from a debt overhang problem. Here, equity holders naturally would be reluctant to put up new equity if the benefit mainly goes to the bondholders and creditors (Myers (1977)). Hence, the underinvestment problem created by buybacks should indeed be more important for distressed firms. Buying back stock to manipulate earnings per share in compensation agreements also seems to be less likely of an issue for firms in distress as presumably these firms have low or non-existing profitability. As such we are left with three potential motivations for buybacks by distressed firms: stock price manipulation, expropriation of bondholders or workers, or market timing. This last motivation assumes that managers in these distressed firms believe the firm is undervalued because the market has overestimated the probability of failure.

While numerous studies evaluate how shareholders fare subsequent to a buyback announcement, few studies have carefully evaluated the larger picture relating to overall company health and well-being. Moreover, while the average buyback is not harmful, it does not mean that all buybacks are value creating activities. If we focus on a subset of firms where, ex-ante, a buyback seemingly would be associated with value destruction, then not finding such destruction makes the case for buybacks as a force for good and should give pause to policy makers who seemingly hold the transaction in a negative light.

Using a sample of 8,380 number of buyback announcements covering the period 1990 to 2021. We begin by confirming that Altman's Z-score is good predictor of bankruptcy over a forward, three-year horizon. Throughout the paper we compare buyback firms to a control sample composed of firms with similar Z-scores, from the same industry and with similar market-cap, price-to-book ratio and prior six-month returns.

We find no evidence that buybacks announced by financially distressed firms are harmful to shareholders. First, short term announcement returns are on average significantly positive and uncorrelated with z-scores, although firms with higher Z-scores tend to do more buybacks. Second, long-term excess returns using various methods to measure "normal" returns also significantly positive and clearly not worse for companies with low Z-scores: firms in the bottom Z-score quintile experience 36-month excess returns of approximately 11 % when we use the BHAR method or the IRATS method. The corresponding numbers for the total sample are 4.51 % (BHAR) and 10.68 % (IRATS). This comparatively higher performance suggesting that zombie firms are potentially more undervalued compared to other firms, perhaps because of overly pessimistic views of their probability for failure. As such, this is one reasons why financially distress firms engage in buybacks in the first place, despite a Z-score indicating that increasing leverage may not be a wise idea.

Of course, a firm that feels it is undervalued must have financial resources to buy back stock if it is not simply bluffing the market. So next, we determine the source of funding for buybacks. We find that for all buyback, they tend to be more profitable than their peer firms with similar Z-scores. Yet, this is especially the case for the bottom z-score quintile where buyback firms earn an average return on assets of 9.10 % over the fiscal year of the announcement and the subsequent fiscal year compared to 3.37 % for their peer firms. As such, these contemporary earnings are the primary source of funding for buybacks in general and for distressed buybacks in particular.

Addressing other key criticisms of buybacks, we find that capital expenditures of buyback firms are *not* significantly lower than that of the comparable firms, rejecting the hypothesis that buybacks occur at the expense of investment. Moreover, the dividends/asset ratio tends to be higher in the buyback group inconsistent with the critique that buybacks are a substitute for paying dividends to avoid paying higher taxes on dividends. Finally, consistent with the notion that buybacks are funded out of contemporary earnings, we see also very little change in total long-term debt levels.

If buybacks create financial distress, we should see a meaningful decline in Z-scores after the buyback. While we find a reversion in firms with the highest z -scores after a buyback, we find a post-announcement an *improvement* in z-scores for the riskiest firms. Interestingly, we find a similar result for the control firms suggesting that common macro-factors are driving the upward revision in z-scores. Further investigation reveals that the variable that is most responsible for z-score changes is the market-to-book ratio. As such, we concluded that there is no meaningful evidence that buybacks create financial distress.

Another approach to addressing the question of whether buybacks cause is to evaluate the question in reverse. Namely, among all bankruptcy cases in the U.S., to what extent are the cases are associated with a buyback? The answer is negative: firms which eventually file for bankruptcy show a *reduced* likelihood for

a buyback in the preceding five years. Instead, the vast majority of bankruptcy cases are largely due to slowing sales and asset growth, higher levels of debt growth and higher levels of debt more generally compared to matching firms. These real effects in firm dynamics though appear, on average, to be unrelated to buybacks. Instead, at least in these bankruptcies, managers in the years leading up to their firms' demise appear to have naturally refrained from the transaction.

In short, we find no support for the argument that buybacks cause harm. By focusing on firms already in comparatively high financial distress, we find no deleterious effects on shareholders, workers or bondholders. Instead, the opposite seems to be true: on average markets are too pessimistic about the value of distressed firms. For these undervalued firms, a buyback represents an opportunity to benefit long-term shareholders, even if these cases have the markings of distressed firms.

Our conclusions seem to be the opposite of Chen and Wang (2012) who examine buybacks by financially constrained firms. Financially constrained firms are defined using the Kaplan and Zingales (KZ) index (1997). They find that buybacks announced by financially constrained firms are followed by negative long-term excess returns. It should be noted that financially "constrained" is not identical with firms in financial "distress." Financially constrained firms are defined by KZ as firms with high Tobin's Q and leverage, but low operating cash flows, cash balances and dividends. Table 6 in their paper shows that in the year before the buyback the average Z-score is 6.13, indicating a low probability of financial distress and not very different from the 6.4 score of the unconstrained firms. The implicit assumption of Chen and Wang (2012) is that financially constrained firms should issue equity to meet their financing needs. But given that these firms, on average, are not financially distressed, it is not obvious why this should be the case. Optimal capital structure under the static trade-of theory implies trading off the benefits from debt financing such as the tax deductibility of interest payments and reduced agency costs of equity against expected costs of financial distress. The fact that firms do not issue stock means that the benefits from increasing leverage are perceived to be higher than the costs. Chen and Wang (2012) suggest that "hubris" is motivating these buybacks, i.e., managers wrongly believe the stock is undervalued, but it could also indicate a desire to lower corporate taxes and agency costs of equity.

Our paper also contributes to the growing literature on zombie firms and their wider economic causes and consequences. Zombie firms' emergence has its roots entangled with the banking sector's 'zombie lending' habits. This practice involves banks channeling loans towards fragile firms, which then grapple to meet debt obligations from their ongoing profits. Caballero, Hoshi, and Kashyap (2008) investigate this lending trend in Japan, and demonstrate its adverse effects on healthy firms competing with these impaired entities. Adalet McGowan, Andrews, and Millot (2018) expand this analysis to a wider sample of OECD countries, and show that industries with a larger capital share in zombie firms tend to see reduced investment and

employment growth compared to non-zombie firms. Banerjee and Hofmann (2018) broaden the scope further, tracing the trend back to the 1980s across several business cycles. The ascent of zombie firms surviving over time has emerged as a significant pattern in the global economy, with their numbers growing from about 4% of all listed firms in the mid-1980s to an estimated 15% in 2017, as per Banjerjee and Hoffman (2018) and Altman, Dai, and Wang (2021). Previous research has pinpointed weak banks as a significant factor in sustaining zombie firms (Caballero, Hoshi, and Kashyap (2008); Storz et al. (2017); Schivardi, Sette, and Tabellini (2022)). Additionally, a comparatively low interest rate environment may have alleviated the urgency for creditors to consolidate their balance sheets, leading them to prolong loans to zombie entities (Banerjee and Hofmann, 2018). Furthermore, Altman, Dai, and Wang (2021) have observed that the growth of the high-yield debt market has fueled global zombieism – allowing weak firms to perpetuate.

While considerable attention has been paid to the causes and broader impact of zombie firms on markets, there remains limited understanding of the internal dynamics of these firms and how their operational strategies influence their financial health. This paper seeks to address this void by examining the implications of buybacks by zombie firms. Our proxy for the extent to zombieism, Altman Z-Score, does a good job in evaluating the financial health of the firms and exhibits a monotonic negative relationship with bankruptcy probability. In our analysis, firms identified as zombies (those with a low Z-Score) tend to have higher leverage, lower asset turnover and lower return on assets. Although definitions of zombie firms vary, Banerjee and Hofmann (2022) also observed analogous patterns. However, in our findings, zombie firms seem to finance their repurchase programs with current earnings, and their investment levels are no less than those of firms with higher Z-Scores. Moreover, zombie firms that undertake buybacks witness a subtle uptick in their financial health. These findings underscore the heterogeneity within the category of zombie firms, suggesting that a more nuanced exploration is warranted in the existing literature on the subject. Z-scores, which are widely used in the financial industry, may be an imperfect measure to classify some firms as zombies, leading to undervaluation, to which these firms respond with a buyback.

This paper also contributes to the debate between the two major theories of capital structure: the static trade-off theory that argues that firms move to an optimal capital structure by trading off the tax benefits from debt against the expected costs of financial distress and the pecking order theory that argues that firms prefer internal financing rather than issuing equity when they are undervalued. Our results clearly reject the static trade-off theory and support the relevance of information asymmetries: when firms are undervalued and appear relatively distressed, they may still choose to increase leverage in spite of the high expected costs of financial distress.

2. Related literature

Over the last four decades, there has been extensive research on the effect of buybacks on both short- and long-term shareholder value. Initially, research focused on explaining the positive short-term returns observed when buybacks are announced (Dann (1981), Vermaelen (1981)). This is consistent with buybacks being initially interpreted by the market as a positive signal, especially when insiders are not selling their shares.

Buybacks have become global since 2000. Before then, repurchases were frowned upon by regulators in many countries for several reasons including the ability of buybacks to: potentially manipulate stock prices, serve as an indirect way to engage in insider trading, avoid paying taxes on dividends, and as a method that hurts creditors and other stakeholders with fixed claims including employees (Wang, Yin, and Yu (2021)). Over time each of these criticisms has been addressed. Concerns about manipulation were dealt with by imposing restrictions on trading volume. Concerns about insider trading were to some extent dealt with by blackout periods prior to earnings announcements limiting days where buyback trades could occur. Concern about creditors was easily mitigated via covenants.

One of the biggest drivers for why buybacks are announced relates to the extensive use of employee and executive incentive stock options (Kahle (2002)) which have the potential to dramatically decrease leverage in the firm and amplify the number of shares outstanding. By construction, a buyback can offset the implied issuance of equity (or dilution in ownership) when options are exercised. Options can also be beneficial if a company chooses to replace dividends with buybacks. First, they serve to disgorge cash in a globally tax efficient manner. But further, managers who are compensated at least in part with options also benefit as this eliminates the implied increase in their options' strike price which occurs when dividends are paid, a change which is avoided with the same wealth transfer occurs through a buyback.

Regarding long-horizon returns, Ikenberry, Lakonishok, and Vermaelen (1995) were first to report the repurchase anomaly within U.S. data after examining long-term returns subsequent to open market repurchases, the most common technique firms use to harvest their own shares. They find that excess returns are especially large for value stocks. Subsequently, Ikenberry, Lakonishok, and Vermaelen (2000) confirm their U.S. findings using Canadian firms, again finding value stocks generated higher abnormal returns, a notion consistent with underpricing. Note that in contrast to the benefits mentioned supra, the value creation for long-term holders comes at the expense of other shareholders who sell their undervalued shares to the company. Reinforcing this, Chan, Ikenberry, and Lee (2004) affirmed the continuity of drifts after repurchases, observable both in the short- and-long term. More recent studies by Manconi, Peyer, and Vermaelen (2019) using global data, and Lee, Park, and Pearson (2020) ascertain the persistence of positive long-term abnormal returns using more recent data. So, the buyback anomaly seems to persist over time and is global.

The long-term positive excess returns are the strongest evidence against the manipulation hypothesis. If manipulation were falsely forcing prices to elevate above fair value, by definition this would mandate that long-run excess returns subsequent to buyback announcements should at some point be negative. Numerous studies fail to identify negative abnormal returns at any horizon following buybacks.

Gong, Louis, and Sun (2008) put forth persuasive evidence suggesting that the post-repurchase performance improvement, as documented by Lie (2005), likely stems from preemptive downward earnings management. Peyer and Vermaelen (2009) offer robust evidence supporting the overreaction hypothesis as a driver of long-term abnormal returns. Their research reveals that stocks often record the most notable positive long-term excess returns following a significant stock price dip in the prior six months. Other variables that are significantly related to long-term returns include stated managerial confidence (Peyer and Vermaelen (2009)), volatility (Evgeniou, et al. (2018)), gender diversity (Evgeniou and Vermaelen (2017)), managerial trustworthiness (Huang, Snellman, and Vermaelen (2022)), net insider buying (Cziraki, Lyandres, and Michaely (2021)), sentiment (Liang (2016)), governance quality (Caton et al. (2016)) and whether the repurchase is executed using an accelerated buyback mechanism (Michel et al. (2011)).

Despite this rich literature supporting the benefits of buybacks to shareholders, a public perception as expressed in the main-stream media and also by mostly progressive politicians[3] vociferously argues otherwise. These arguments of harm to other stakeholders are also expressed by academics such as Bill Lazonik.[4] There are two common theses often emerging from these skeptics. First, these critics argue that buybacks make firms financial unstable and thus impose financial distress costs on workers. Second, they argue that buyback programs have detrimental effects on economic growth, and thus harm society at large. They argue that repurchases, by construction, divert capital away from investment and innovation, and instead help managers achieve other short-term objectives, such as artificially enhancing earnings per share, which in turn can directly and indirectly affect management's compensation. There is some evidence to support this latter view, Grullon and Michaely (2004) for example do not find evidence that repurchase programs are followed by an increase in operating performance. Instead, they report that buybacks are followed by a reduction in systematic risk, and thus argue that the long-term excess returns subsequent to buybacks is explained by markets only slowly learning that buybacks signal a reduction in the cost of capital. Of course, the argument that buybacks destroy growth and innovation in the economy relies on two key assumptions.

---

[3] Natalia Renta. "Congress Takes Historic Step to Tax Stock Buybacks" Inequality.org. August 10, 2022. (See https://inequality.org/research/congress-takes-historic-step-to-tax-stock-buybacks/#:~:text=%E2%80%9CI%20hate%20stock%20buybacks%2C%E2%80%9D,prolonged%2C%20heated%20negotiations%20amongst%20Democrats.%20https://www.cnbc.com/2021/03/02/elizabeth-warren-rips-stock-buybacks-as-nothing-but-paper-manipulation.html\)

[4] Sheelah Kolhatkar. "The Economist Who Put Stock Buybacks in Washington's Crosshairs." The New Yorker. June 20, 2019. (See https://www.newyorker.com/business/currency/the-economist-who-put-stock-buybacks-in-washingtons-crosshairs)

First, is that buyback firms have positive NPV investment opportunities which are being abandoned when a buyback is executed.

Second, this assertion also implies that these firms are constrained from capital markets and thus are prohibited from obtaining additional capital to finance new projects in the future by issuing new equity or debt. This second issue contradicts, though, Fried and Wang (2018) who find that repurchased stock is typically reissued in later periods. Clearly, these issue of limited access to capital markets is not binding for most public companies. However for a narrow subset of firms in financial distress, access to capital may indeed be problematic. Here, concern about underinvestment by zombie-like firms could be a material concern a plausible argument against buybacks, at least for this small segment of cases.

Another concern is that buybacks are used to manipulate earnings per share to increase compensation tied to EPS targets (Brav et al. (2005), Cheng, Harford, and Zhang (2015)) or to meet analyst forecasts (Almeida et al (2018)). As a result, firms pursue short-term objectives at the expense of long-term growth opportunities. Again, these arguments could hold for profitable firms, but this is less true for firms in financial distress. Here, a loss-making firm is only amplifying its losses per share by buying back stock. As such, EPS manipulation as a motive for repurchasing stock is not particularly relevant when focusing on distressed firms.

3. Data & Methods

3.1. The sample

For our buyback sample, we collect open-market share repurchase events from the Securities Data Corporation (SDC) Platinum database over the period 1990-2021. Consistent with previous papers, we exclude firms whose share price at the time of the announcement is less than $3. Return information is obtained from CRSP and accounting data from Compustat. We only include securities with a CRSP share code of either 10 or 11 which are identified as trading on either the NYSE, AMEX, or NASDAQ stock markets Because of the regulated nature of certain companies, we exclude financials (SICs between 6000 and 6999), public utilities (SICs between 4900 and 4999), and firms classified as public administration (SICs between 9100 and 9999).

3.2. Z as a measure of Financial Distress

To the extent that stock buybacks cause "harm" to corporations, it should be most evident in firms nearest to default. As such, we need some measure of financial distress or bankruptcy risk. We use Altman's (1968) Z-score to accomplish this. While other measures of bankruptcy exist, the z-score is straightforward

to calculate with public information and poses the fewest restrictions on providing a risk estimate for our sample.

We apply Altman's model as such:

$$Z = 1.2 \cdot \frac{Working\ Capital}{Total\ Assets} + 1.4 \cdot \frac{Retained\ Earnings}{Total\ Assets} + 3.3 \cdot \frac{EBIT}{Total\ Assets} + 0.6 \cdot \frac{Market\ Value\ of\ Equity}{Book\ Value\ of\ Total\ Liability} + 0.99 \cdot \frac{Sales}{Total\ Assets} \tag{1}$$

In the tables which follow, we sort firms into quintiles based on Z. The cutoffs defining each quintile are formed each year relative to only NYSE stocks which satisfy our inclusion criteria. NASDAQ firms are then sorted into Z quintiles based on these NYSE cutoffs.

Table 1 shows that Z is indeed associated with the potential for bankruptcy. Over the period 1999 to 2018, firms with the highest Z scores experience bankruptcy within three years at the rate of 9 per 10,000 (0.09%). As expected, the rate of bankruptcy increases monotonically as we move to lower Z-score quintiles. For quintile 1 firms, the rate of bankruptcy jumps noticeably at the rate of approximately 20 per 1,000 (or 1.97%) within three years of sorting.[5] If we look across individual years, we see that Z seemingly does a good job each year of identifying firms most at risk of future bankruptcy. For example, during the years leading into the great recession (2006 to 2008) we see an uptick in the frequency of bankruptcy for Z1 firms of 2.89% on average; the corresponding mean for Z5 firms for those same years is .04% with two of those three years showing no bankruptcies at all.

If we take the firms categorized within in the lowest quintile (Z1) and sort them further into three additional subgroups, the result is noisier. Firms with the lowest sub-ranking within Z1 do report a higher incidence of bankruptcy, on average, compared to the higher rankings within that subgroup. Yet separation within this high-risk group is not consistent year to year nor overall during the period from 1999-2018.

Figure 1 and Table 2 show a gradual increase in Z-scores across bankruptcy classifications over time, with local peaks during the 2007-08 great recession and later around 2014. Given that the Z-Score is composed of five factors, we dig further to identifying the primary driver of Z-Score fluctuations over the past decades. As depicted in Figure 2, the most influential component has been the 'Market Value of Equity to Book Value of Total Liabilities' ratio. When scaled by its weight, this factor exhibits significant volatility, rising from 2.5 in 1990 to over 5 by 2020. In contrast, the other four factors, when similarly adjusted for their weights, have shown a consistent and gradual decline during the same period.

---

[5] The percentages shown in Table 1 for each year reflect values over the subsequent three years. This includes both bankrupt and non-bankrupt firms to guarantee an equitable comparison.

3.3. The Control Sample

For several of our tests, we need control firms with similar characteristics to our buyback firms, particularly with respect to their likelihood of bankruptcy. As such, these would be firms similar to our buyback firms along many dimensions, but whose management choose not to initiate a buyback. To accomplish this, as a firm announces a buyback, we first identify all firms at that same point in time which are categorized in the same Fama-French twelve-industry classification. From this list, we eliminate all stocks which made an initial public offering (IPO) in the previous year or announced a buyback within the prior five years. From this potential list, we calculate the robust mahalanobis distance between the buyback target and each potential control firm in that same industry. Among these firms, we choose the five firms with the closest fit when matched on firm-size (log market capitalization at the end of the prior June), book-to-market (from the prior June), Z-score at the time of the announcement, and six-month total return prior to the buyback announcement (ending five days before the buyback announcement).

In Table 3, we show the quality of the match along each dimension. By construction, we match completely on industry defined at the Fama-French 12 industry level. With respect to z-score and prior return, there is no evidence of a mismatch economically or statistically. For size and book-to-market, our buyback sample is slightly larger in size and has slightly a lower book-to-market ratio, on average. While we do observe statistical differences in these variables at traditional confidence levels given our sample size, it is not clear on an economic level that there is much distinction between the two groups.

4. The Market Reaction to Zombie Buyback Announcements

Consistent with numerous studies which examine corporate well-being through the lens of shareholders, we too report stock market performance in both the near- and long-term. However, in this paper, we also measure performance conditional on the potential for bankruptcy at the time of the buyback announcement.

4.1. The Short-Run Evidence

Table 4 reports mean five-day abnormal returns for our sample overall and stratified by Z score. Here, abnormal performance for a given buyback firm is defined as the five-day holding period return surrounding the buyback date (day $t-2$ through day $t+2$) less the equal-weighted mean holding period return of the five control firms matched to that buyback firm.[6]

---

[6] By not rebalancing throughout this five-day period, both the buyback firm and the matching firms are less prone to upward return basis due to bid-ask bounce or mean reverting inter-day noise.

If buybacks post a deleterious cost on the firm, or at least to its shareholders (say by increasing the risk of bankruptcy), we should find that the mean abnormal market reaction to buyback announcements made by firms most at risk of such distress is lower, if not negative, than otherwise. This is clearly not the case. We see in Table 4 that there is no evidence that the stock market perceives buybacks in low-Z firms to be harmful. In fact, the mean announcement return for Z1 firms is 1.59% and is significantly different from zero at the 1% level. Comparing across sub-groups within Z1, we see no evidence, on average, of an adverse market reaction to the announcement of a buyback, including among the very lowest of those in the Z1 category.

4.2. The Long-Run Evidence

One might argue that in the short-run markets may not be able to fully anticipate the increased potential harm for future financial distress caused by a stock buyback. If so, then one might discount the short-run return evidence around the buyback announcement date as insufficient to detect any problem from buy-backs. Moreover, a reversal in long-term returns would also be consistent with the hypothesis that managers might be causing harm via the buyback by manipulating prices in the near-term. As such, we consider the long-horizon return evidence subsequent to a buyback announcement. We do this in several ways. First, we estimate four-year buy-and-hold abnormal returns starting in the month following the buyback announce-ment. Second, we apply Ibbotson's returns across time series technique (or RATS) using the Fama-French five-factor model, also starting in the month following the buyback announcement.

4.2.a Buy-and-hold Abnormal Returns

Table **5** reports buy-and-hold abnormal returns for our sample, both overall and for various sub-group-ings stratified on the basis of their ex-ante exposure to financial distress. This is done over various horizons ranging from three- to forty-eight months. If buybacks cause harm to those firms which execute them by harming future investment, increasing the risk of failure or some other malady, then one should expect to see poor stock returns going into the future. This should be most apparent in firms with high ex-ante expo-sure to financial distress.

However, in Table **5**, we find no compelling evidence of a decline in long-term stock returns. For the overall buyback sample, the abnormal return is positive at traditional significance levels for each holding period from three months to forty-eight months. If we focus more narrowly on Z1 firms, again we see no evidence of adverse market performance. These firms which have a higher propensity for failure have pos-itive average abnormal performance of 12.85 % relative to control firms with the same matching character-istics measured over a 3-year horizon. Over a four-year window, this abnormal return expands to 24.40%. Both measures are significant at the 1% level. This compares to a mean abnormal holding period return for

12

all other firms ranked Z2 through Z5 of 3.61% and 8.48%, respectively at the 3- and 4-year mark. If we build a long-short portfolio of Z1 against Z2 through Z5 combined, the arbitrage spread at the 3- and 4-year mark is 9.66% and 16.00% respectively with both estimates significant at the 5% level.

Sorting the Z1 portfolio further to a more granular level, we see no evidence of poor performance even among those firms with the very highest propensity for failure. In fact, the point estimate for the thirty-six-month abnormal return for the lowest quartile of z scores in the Z1 grouping is highest compared to all other portfolios reported in this table. Additionally, we further divided the entire sample period into three distinct sub-periods: 1990-1999, 2000-2009, and 2010-2017. This disaggregation aims to examine the temporal heterogeneity in Buy-and-Hold Abnormal Returns (BHAR). Detailed results of this analysis are presented in Appendix Table . Across these intervals, the data does not reveal a statistically significant negative mean difference in BHAR between firms with low Z-scores (Z1) and those with higher Z-scores (Z2 to Z5). This finding reinforces the robustness of our initial conclusion; there is no indication either in the cross section or time-series that stock buybacks cause harm, even among firms most at risk for financial distress.

4.2.b Fama-French Five-Factor RATS

Here, we estimate long-horizon returns using an alternative approach to control for risk by applying the Fama-French five-factor model using Ibbottson's return across time series approach (RATS). For all buyback firms in our sample, we align them in event time where $j = 0$ represents the month when the open market repurchase is announced. Then for each month j where j goes from zero to forty-eight, we estimate a cross-sectional regression where for each firm the corresponding Fama-French factors for that same month form the independent variables. The resulting alpha from this regression represents the abnormal returns for each event month j. We estimate these alphas over specified time periods ranging from +12 to +48 months. Here, a buyback firm remains in the sample as long as possible and simply falls from the sample at time lapses or after the last partial month its returns are recorded on CRSP. The intercepts obtained from these alpha j values are then summed up to derive the cumulative abnormal return (CAR) figures. The standard error for a given event window is determined by taking the square root of the sum of the squares of the monthly standard errors. Comparisons between this table and the buy-and-hold approach will differ for a variety of reasons. A key reason is that as we cumulate alphas in this RATS procedure, we are implicitly assuming monthly rebalancing which can lead to an upward bias in our point estimates.

Consistent with what we observed earlier using buy-and-hold returns, we see no evidence that firms which announce a share repurchase show any sign of financial distress at least as measured by future equity returns. For the entire buyback sample, the 48-month CAR is 14.7% and is significant at traditional confidence levels. Focusing more narrowly on Z1 firms, we see no evidence that they experience the

13

comparatively poor stock performance one would expect if buybacks caused harm. Their 36-month CAR of 11.14%, is similar to the average CAR of 10.76% for all other firms categorized in the Z2~Z5 portfolio. We obtain similar results between the Z1 and the Z2~Z5 portfolios too; 16.81% for Z1 compared to 18.15% but again no statistical difference between the two. Digging deeper, if we look within the Z1 portfolio and look at firms with the greatest exposure to financial distress (Z1-Low), we find no evidence of subsequently poor performance.

The results are inconsistent with the notion that managers manipulate stock prices by giving false signals. Perhaps more importantly, by focusing buyback firms already at or near financial distress we find no evidence that buybacks somehow cause harm. Rather, distressed firms tend to be undervalued and managers appear to take advantage of this undervaluation to benefit of long-term shareholders.

Alternatively, it is plausible to consider that perhaps the gains to shareholders come at the expense of other stakeholders (bondholders, employees) who see the risk of their claims increase. Or perhaps the gains to shareholders come at the expense of underinvestment in positive NPV projects. In the next section we will explore these alternative hypotheses in detail.

5. The funding source for buybacks

Critics of buybacks argue that by distributing capital to shareholders drains away capital that could otherwise be used to reinvest in the business. Of course the same criticism could also be levied against dividends, as well. Nevertheless, to the extent that buybacks cause harm due to underinvestment or a perversion of capital structure, we should see a decrease in capital expenditures and a meaningful increase in leverage. Further, we should see deterioration in various measures of operating performance relative to a control sample if buybacks somehow weaken a firm's competitive stance in the economy. Of course, these patterns should be most apparent in firms with low Z scores who are either in or near the brink of financial distress. As such, we consider two questions in this section. First, we look at capital flows into and out of the firm before and after the buyback announcement to assess their financing source. Second, we examine the extent to which buyback firms contract new capital investment relative to comparably matched firms.

To construct Table 7, we aggregate the flows from the fiscal year of the announcement with those from the following fiscal year, yielding a two-year cumulative figure, to account for any potential changes in

flow.[7, 8] All variables are normalized using the firm's average total assets, determined from the start and end of the fiscal year in which the announcements were made. We use the cash flow identity[9]:

$$(Earning + F.other + Invsale.net + Dlt.net + Sppe + Sstk.net + Dlcch)$$
$$- (Capx + Dv + Aqc) + \epsilon = Chech \tag{2}$$

Variables are defined as follows:

- $Earning$: Income Before Extraordinary Items (Compustat Item 123) + Depreciation and Amortization (Item 125) + Extraordinary Items and Discontinued Operations (Item 124).

- $F.other$ (other funds): Deferred Taxes (Item 126) + Equity in Net Loss (Earnings) (Item 106) + Funds from Operations – Other (Item 217).

- $Invsale.net$ (net sale of investment): Sale of Investments (Item 109) – Increase in Investments (Item 113).

- $Dlt.net$ (net of long-term debt issuance): Long-Term Debt – Issuance (Item 111) – Long-Term Debt – Reduction (Item 114).

- $Sppe$ (net sale of property, plant and equipment): Sale of Property, Plant and Equipment (Item 107) + Sale of Property, Plant, and Equipment and Sale of Investments – Loss (Gain) (Item 213).

- $Sstk.net$ (net sale of common and preferred stock): Sale of Common and Preferred Stock (Item 108) – Purchase of Common and Preferred Stock (Item 115).

- $Dlcch$: Change in Current Debt (Item 301).

- $Capx$: Capital Expenditures (Item 128).

- Dv: Cash Dividends (Item 127).

- Aqc: Acquisitions (Item 129).

- $Chech$: Cash and Cash Equivalents – Increase (Decrease) (Item 274).

- ϵ (residuals to make the cash identity equation holds): Source of Funds – Other (Item 218) + Uses of Funds – Other (Item 219) + Working Capital Change – Other – Increase (Decrease) (Item 236).

While buybacks may not be causing problems in the general case, perhaps we should examine these same questions in marginal firms more at risk of bankruptcy at the time of the buyback announcement. In Table 7 Panel A, if we focus on buybacks classified in the Z1 grouping most prone to financial distress, we do see a meaningful outflow of capital devoted to net stock repurchases equal to -2.13% of the asset base over two fiscal years. This compares to an inflow of 6.34% (suggesting issuance) for the control firms in

---

[7] Overlooking the fiscal year of the announcement and focusing solely on the subsequent fiscal year doesn't alter our conclusion. The table can be provided upon request.

[8] We measure actual repurchases over a two-year window since Stephens and Weisbach (1998) Stephens and Weisbach (1998) show that firms acquire 67–79% of shares announced within a two-year period.

[9] The cash flow identity and the components used to formulate the variables are derived from the "Cash Statement by Source and Use of Funds" section in the Compustat North America User's Guide. Certain variables are aggregated to assess the net impact of a firm's activities.

the same period. Turning to Panel B, which details the differential in each flow metric between repurchasing firms and their control counterparts, there's an insignificant disparity in net long-term debt issuance ($Dlt.net$) across the two fiscal years post-event. The 8.46% difference in net stock repurchases cannot be ascribed to flows from other funds ($F.other$), net sales of investments ($Invsale.net$) or change in current debt ($Dlcch$). Instead, looking further we clearly see that these buybacks, even in these most distressed organizations, are primarily funded through contemporary earnings ($Earning$). Meanwhile, the sale of property, plant, and equipment plays a more secondary role in their financing for Z1 firms.

Earnings as a function of total assets in Z1 buyback companies are over 11% higher than the corresponding control firms. Looking across all subgroups in Table 7, we see no evidence that debt is a primary funding source for the buyback. Instead, most buybacks appear to be financed nearly entirely by earnings produced in the two fiscal years after the event.

Another claim that critics of buybacks profess is that buyback firms withhold new capital investment and thus harm the firm's productive capability in the future and threaten job formation. We see no support for this claim in Table 7. Capital investment ($Capx$) is about the same as or higher compared to the corresponding control group overall in each sub-category of Z score grouping. Further, we see no cut in dividend payments nor cuts in acquisitions as a potential funding source for the buybacks. The fact that there is no evidence that the buyback firms cut their dividends when they buy back stock is consistent with the hypothesis that dividends are sticky, and firms don't see buybacks and dividends as perfect substitutes.

While Table 7 shows the dividend policy and financing policy following the buyback, Table 8 and 9 show whether buyback firms change their leverage and dividend policy during the four years around the buyback relative to their peers. Although, as expected, higher Z scores correspond to lower leverage, only the buyback firms classified in the Z1 sample show a significantly higher level of debt than the firms in the matching sample. Buyback firms classified in the Z5 sample on the other hand show significantly lower financial leverage than their matching firms. However, these differences are unrelated to the year of the buyback. As such, the buyback itself does not appear to signal a move to higher target leverage. Instead, the buybacks appear to be opportunistic: taking advantage of undervaluation, at times when the firm's contemporary earnings can finance the transaction.

The column labeled "Dif" in Table 8 presents the average difference between post-announcement performance (from T+1 to T+4) and pre-announcement performance (from T-4 to T-1). On average, among all groups, only the Zombie firms (Z1 firms) show no significant increase in leverage in the four years following the event compared to the four years preceding it. The other cases do so a change.

Table 9 shows that, as expected, firms with lower financial distress pay more dividends, however the buyback itself does not signal a change in dividend policy relative to the control firms. One criticism of buybacks is that they are driven simply by tax motivations. This table does not lend support to the substitution hypothesis due to taxes.

In short, while there may be extreme, individual cases where buybacks cause harm, we see no general evidence consistent with the claim that buyback firms are placing themselves in peril by increasing leverage and simultaneously cutting back on new investment. Rather, it appears that undervalued firms are financing this buybacks with excess capital over and above their concurrent investment needs in order to take advantage of undervaluation. This opportunistic behavior appears to have no impact on long-term financial policies, such as dividend policy and capital structure.

6. Buybacks and their impact on financial distress

6.1. Z Scores

If buybacks cause harm as critics suggest by pushing the firm into greater financial distress, we should observe a decline in Z scores subsequent to a buyback announcements, particularly for those firms which repurchase a meaningful portion of their share base. As such, the extent of harm buybacks cause should be tied, at some level, to the scale of stock being retired.

To assess this, we divide buyback firms into quintiles based on the change in their outstanding shares from the announcement day to six months later. Table 10 details the variation in Z-Scores from four years before to four years after the buyback announcement. Notably, firms in the "Share Chg 1" quintile (firms which experienced the greatest contraction in their share base), experienced an average decrease in outstanding shares of -8.21%, compared to a 2.99% increase in their matched counterparts. Among these large buyback programs, we do observe a minor decline in their average Z-Score in the four years after compared to the four years preceding the announcement; a decline in Z-Score from about 5.6 to about4.6. Yet this post-buyback Z-score of 4.6 suggests that even these large programs imposed at little financial distress. Perhaps more importantly, the lack of statistically significant differences in the Z-Score decline between the buyback firms compared to a similar trend we also see in the control firms suggests that this decline in Z-scores post buyback could be due to broader macroeconomic factors rather than due to any harm caused by the buyback. This pattern is consistent in all three groups where buybacks on average led to a contraction in shares ("Share Chg 1, 2, and 3"). This is not the case for cases where the share base actually *expands* subsequent a the buyback announcement ("Share Chg 4 and 5"). In the latter group, the financial health of buyback firms is stronger than that of their matching firms. Interestingly though, even in these cases where

17

the share base is expanding, we also see modest deterioration in the absolute level of the Z-score in both the buyback firms and in the control firms. These trends suggest a common macro-economic event occurring around some buyback announcements. Yet with respect to the critics of buyback programs, we find no indication that stock buybacks lead to a meaningful deterioration in firm financial health regardless of the level of quantity of shares repurchased.

Table 11 is structured similar to Table 10 but shows the evolution of Z-scores for buyback and matching firms stratified by their Z-score ranking at the time of the announcement. Focusing first on high Z-score firms in Z5 (low financial risk), we see some evidence of a decline in mean Z from 9.12 to7.54. However, notwithstanding this decline in Z-score, it is clear that the risk of bankruptcy in the post-buyback period is still remarkably low; there is no evidence of material financial distress attributable to the buyback. Interestingly, we also see a similar downward shock in Z-scores for the matching firms suggesting that some type of macro-event unrelated to the buyback was occurring around the time of these buyback announcements. As a final point, it is also interesting to note that these low financial risk firms categorized in Z5 comprise roughly 40% of the sample. With such a titled sample bias, this suggests that managers may exhibit natural conservative tendencies where financially distressed organizations organically shy away from this transaction, thus drawing into question the need for regulatory intervention.

Of course, the Z5 population is not our primary target of interest. Instead, the buybacks of greatest concern for regulators should be low Z firms who at the time of the announcement have more exposure to financial distress. For Z1 firms who announce a buyback, we see no evidence of a subsequent decline in Z-score. In fact, in Figure 3 we see a mild *increase* in the average Z-score from 1.54 (T-1) to 1.92 (T+4) over the four years following the announcement. Interestingly, though, this is also accompanied by an increase in the mean Z-score for the matching firms as well. Again, we reach the conclusion that there is no meaningful evidence of a change in bankruptcy risk from firms most at risk for financial failure which can be attributed to buybacks.

6.2. Credit ratings

If stock repurchases inflict harm on the future financial health of the firm, we should observe a decline in the credit ratings of these firms as they repurchase stock. This should be particularly true for low Z-score firms. In Table 12, we report median credit ratings by Z score at the time of the buyback announcement. Again, consistent with our findings on how Z evolves surrounding buyback announcements, there is little evidence of an erosion in credit worthiness after a buyback announcement. Following the repurchase announcement, the median credit rating for Z1 firms is *upgraded* from BB to BB+ within two years. For all other firms combined (with Z-scores ranging from Z2 to Z5), there is no evidence of a change in

creditworthiness; they consistently maintain a BBB+ rating after the buyback announcement. The only evidence of a mild degradation in rating is observed in firms categorized in Z5; their rating declines from A to A- within the two years following the buyback. This mild reversion in rating may be related to broader macro-economic conditions, but not withstanding this change, these high credit ratings do not suggest these buyback firms are imperiled.

7. Buybacks and Firm Bankruptcy

In the preceding sections, we began by examining all firms engaging in share repurchase announcements. In this section, we adopt the reverse. Here, we will shift attention to all firms that have filed for bankruptcy, with the objective of constructing a matched sample and conducting a comparative analysis of the performance exhibited by these two distinct groups. In particular, the question we seek to address is whether share buybacks are a material cause for the bankruptcy filings we see in the U.S. To the extent this is true, policy interventions limiting the extent of buybacks at least might plausibly worth of some consideration.

We begin by extracting bankruptcy filings for either Chapters 7 or 11 from the Audit Analytics database. We then analyze financial performance in the five fiscal years preceding the bankruptcy filing date, which we will henceforth refer to as "treatment firms." To ensure data integrity, treatment firms lacking financial data for the five-year period prior to their bankruptcy filing date are excluded from this analysis.

We also construct a matching sample at fiscal year $t - 5$. Here, we minimize the distance between each treatment firm and its corresponding matching firm based on four crucial factors: firm size, BM ratio, Z-score, and Fama-French 12 industry classification. Firm size (specifically the logarithm of market capitalization) is determined at the end of June in fiscal year $t - 5$. The BM ratio is calculated using the book equity value for the last fiscal year-end in $t - 6$ and the market capitalization at the end of December of the previous year. The Z-score is then derived from the financial data available for the last fiscal year-end in $t - 6$. By employing this matching procedure, we ensure that the treatment firms and their respective matching firms are comparable in terms of essential financial metrics and industry characteristics.

Consistent with our earlier work, we focus on bankruptcy filing between 1990 and 2018. After eliminating observations with missing values and merging the dataset with CRSP, the final bankruptcy sample comprises 729 observations. For each of these firms, we identify matching firms; matching five control firms for each for each treatment firm. Table 13 presents the quality of the match. As before, we have a perfect match within the same Fama-French 12 industry classification between treatment and their

respective matches. Furthermore, no statistically significant differences were found between treatment firms and matching firms in relation to BM, Z-Score, and Size.

To address the possibility that bankruptcies may cluster in particular moments in time, we extend our matching technique to encompass the entire economy. Here, we compare our treatment firms against *all* other existing firms in the market. The inclusion of the whole economy group serves to establish a baseline for assessing what may be happening in the broader economy. In summary, our analysis encompasses three groups of firms: the treatment firms, their matching counterparts (on a one-to-five ratio), and the economy aggregate (encompassing all other firms in the market), facilitating a comparative analysis.

Figure 4 and 5 provide an overview of the temporal evolution of firm characteristics across the aforementioned three groups:. Five years prior to the bankruptcy filing of treatment firms, there is no statistically significant difference in Z-Score between the treatment firm group and the matching firm group, as illustrated in Table 14. However, as time progresses, the Z-Score of the treatment firm group gradually declines from 2.94 to 0.58 and becomes significantly lower than that of the matching firm group. This consistent pattern conforms to the interpretation of the Z-Score as a measure of firm health, indicating that the Z-Score of firms that eventually go bankrupt tends to decrease as one would expect. In contrast, the Z-Score of the entire economy remains relatively stable, hovering around a value of 5, a level considerably higher than that of both the treatment and matching firms. This divergence can be attributed to the presence of relatively high positive values in the Z-Score distribution of the entire economy, even after applying winsorization to all financial variables at the 5% and 95% levels. In addition to the change in Z-Score evident in these figures, we see that treatment firms (those heading towards eventual bankruptcy in five years) generally exhibit significantly lower sales growth, lower asset growth, lower dividend payout, and lower profitability (both ROA and ROE). Consistent with intuition, these firms show significantly higher leverage in comparison to their matched sample.

Is it possible that buyback programs contribute to financial distress and the eventual failure of these companies? One approach to investigate this is to examine whether firms that eventually go bankrupt spend disproportionately more on repurchasing common shares compared to their matching firms. Previous evidence we reported in in Figure 5 and 6 does not align with this hypothesis. Nevertheless we investigate this question here. We see no significant difference in the total shareholder payout ratio (scaled by assets) between treatment firms and matching firms starting five years prior to the bankruptcy filing. However, starting from year -4, the total shareholder payout ratio of treatment firms consistently decreases below that of matching firms; the gap between the two groups reaches its maximum in the last year.

Total shareholder payout is the sum of dividend and purchase of common and preferred stocks. Removing the factor of dividend payout ratio, we observe that the scaled value of purchases of common and

preferred stocks follows a similar pattern to the total shareholder payout ratio. Treatment firms, in the years preceding their bankruptcy filing significantly curtail the level of capital allocated to repurchase common and preferred shares compared to their matched counterparts. Furthermore, these expenditures by treatment firms are considerably below the corresponding levels of the entire economy sample. In short, to the extent we find distress firms repurchasing shares, managers in these firms have largely elf-regulated and shut these programs down in advance of eventual bankruptcy.

In addition to examining the purchase of common and preferred stocks, we also investigate the incidence of buyback announcement events over time across the three groups. If buyback operations were a significant driver of bankruptcy, we would expect to observe a higher incidence of such events for treatment firms compared to matching firms and the entire economy group in certain years preceding the bankruptcy filing. Yet again, the empirical evidence contradicts this hypothesis. As depicted in Figure 6 and Table 15, the incidence of buyback announcements for treatment firms is consistently lower than that of the matching firms and the entire economy group. From five years prior to the bankruptcy filing to four years before, only 4.39% of treatment firms have announced buybacks. This percentage gradually decreases to 0.08% one year prior to the filing date.

To sum up, instead of focusing on the financial health of firms engaging in buybacks, the approach in this subsection takes a reverse approach by examining all firms which eventually file for bankruptcy. The financial health of these treatment firms, of course, deteriorates over the five years leading into the filing. These firms exhibit slower sales and asset growth, lower revenue, and higher levels of debt compared to the matching firms. These organic challenges more so than buybacks appear to be the fundamental threats to their eventual demise. Moreover, we observe a significant disparity in the incidence of buyback announcements between treatment firms and matching firms. The frequency of repurchase announcements for treatment firms is significantly lower. Additionally, the amount of money allocated to the purchase of common and preferred shares, scaled by assets, is also lower for treatment firms compared to matching firms.

These findings support the notion that firms repurchases are not a fundamental cause of bankruptcy. These failures are largely driven by adverse organic shifts in firm performance paired with high-debt loads, attributes we are not seeing in buyback firms (even those with low Z-scores). There is no evidence that buybacks are a key factor driving firm failures.

8. Self-restraint in the execution of Buyback Programs

Critics of buybacks who seek to either reduce or eliminate the transaction because of its potential to harm the firm may not be considering the rational actions of the firm's agents. If we assume for that managers have some self-interest (financial, reputational or otherwise) in seeing the firm survive into the future and if we also assume that buybacks could, if inappropriately applied, put a firm in financial peril, then we should expect firms with high exposure to financial distress to voluntarily repurchase less stock subsequent to a buyback authorization announcement compared to firms who have less ex-ante distress. Note that open market repurchase authorizations are options to repurchase stock, not firm commitments.

8.1. Buybacks as a function of Total Assets

In Table 16, we report the amount of capital firms spend on stock buybacks as a function of total assets at year-end prior to the year of the buyback announcement. Skipping the buybacks amounts expended in the year in which the buyback authorization announcement was made (a partial year), we report buyback amounts for the next three full fiscal years. Consistent with this notion of managerial self-restraint, we see that firms with high z scores (and thus little ex-ante exposure to financial distress) repurchase more stock compared to those with low Z scores. For example, after three years firms classified as Z1 at the time of the buyback announcement on average repurchase roughly only half compared to Z5 firms; 2.97% versus 5.96%. This sign of self-restraint may explain why it is that we see little evidence of increased financial distress among firms which seemingly have higher exposure to financial distress at the time of the buyback announcement.

8.2. Changes in Actual net share count

An alternative approach to observing whether managers of low z-score firms exhibit self-restraint when executing buybacks is to look at overall share count over time. Whereas in the prior section we were looking at the gross amount of funds spent on buybacks, looking at actual share counts allows us to also take into account any issuance of stock the firm might simultaneously be making. For example, even if there are no material financing needs, firms may be buying back meaningful quantities of stock to offset the share issuance effects arising from employee stock options or stock grants, thus clouding the picture of just how much of a fundamental shift in equity structure of the firm is really occurring.

Thus, in this section, we calculate the percentage change in actual shares outstanding relative to the buyback announcement day by using the following formula:

$$Pct = \frac{Share_{the\ end\ of\ month} - Share_{announcement\ day}}{Share_{announcement\ day}} \tag{3}$$

where $Share$ denotes the shares outstanding.

Table 17 presents the changes in actual share count over the three years following buyback announcements. As anticipated, in the full sample, buyback firms issue notably fewer net shares on average compared to control firms, with rates of 17.57% versus 25.43%, respectively. The median 36-month net share change for buyback firms stands at a negative -1.77%, while for the control sample, it's positive at 3.25%. Examining the proportion of instances where shares outstanding decrease within three years post-buyback, the buyback firm cohort exhibits a higher ratio compared to the control group.

When comparing buyback firms in the Z1 group to those in the Z2~Z5 group, the Z1 group exhibits greater net share changes, both in mean (20.35% vs. 17.28%) and median (-0.29% vs. -1.88%). Additionally, while 51.1% of firms in the Z1 group reduced their shares, this percentage is surpassed by the Z2~Z5 group at 58.00%. These findings indicate that managers of firms with lower Z-Scores tend to be more conservative in actions.

To better understand the temporal change in shares outstanding over the same duration, we detail the cumulative percentage changes on a quarterly basis in Table 18. When comparing the Z1 and Z2~Z5 groups once more, it's evident that the shares outstanding for low Z-Score firms grew at a faster pace compared to high Z-Score firms during the initial three quarters. This again reinforces the notion that managers of firms with lower Z-Scores demonstrate prudence in their buyback strategies.

9. Post-Announcement Operating Performance

If buybacks directly or indirectly cause some harm to the firm or its constituents, it should be evident in the firm's operating performance. In the sections which follow, we explore various accounting measures as a function of the firm's total assets for both buyback and control firms. In each of these tables, we treat the announcement quarter as $t = 0$. We then cumulate information in groups of four quarters to create "four years" of accounting information both prior to and following the announcement quarter. This is done for both sample and control firms.

9.1. Are workers harmed?

Critics suggest that buybacks divert money away from workers and toward shareholders. While we have established that capital is indeed being distributed to shareholders, it is unresolved to this point as to whether this gain for shareholders is coming at the expense of workers. Table 19 addresses this by reporting SGA as a function of total assets surrounding the buyback announcement. While there is a change in the overall level of SGA across Z groupings, matching firms show the same bias. When we look at relative

trends over time and across Z groupings, we reach a similar conclusion; there is no evidence of a meaningful change in SGA as a function of total assets either before or after a buyback announcement.

9.2. Do firms become more efficient, perhaps at the expense of workers?

Sales to Assets (or asset turnover), a measure of firm productivity, is associated with the Z grouping. High Z scores are associated with high asset turnover and likewise low Z firms are associated with low asset turnover. This holds for buyback and control firms alike. However, over time we see in Table 20 no meaningful break in this ratio between the buyback and control firms. The overall trend in asset turnover is slightly negative. This contradicts the notion that workers are being forced to absorb productivity gains. We do observe a bump in productivity for low Z-score firms following a buyback announcement, however we see the same trend in control firms, as well.

9.3. Does ROA decline after a buyback?

If buybacks divert capital away from new capital investment in a sub-optimal fashion that would otherwise increase firm value, we should see a decrease in ROA over time. Table 21, however, suggests little downward trend in firm profitability. Attributable, at least in part to the definition of Z, we do observe that high Z score firms have higher ROA compared to low Z firms. However, within Z grouping, we do not see an adverse trend in profitability consistent with the notion that buybacks lead to added costs of financial distress for the firm.

We do observe that buyback firms tend to report uniformly higher ROA compared to their corresponding control firms. This is especially the case in the year before the buyback and the subsequent years. There is no clear reason for such a distinction, however this result is consistent with the idea that managers of buyback firms may be more confident about the long-term performance of their firms, at least relative to firms with the same Z scores who don't buy back their own shares. The larger confidence may have led to the buyback announcement if managers believed that the market did not share this optimism.

10. Are Managers Undoing Potentially Adverse Effects Before They Materialize?

If we suppose for a moment that buybacks do meaningfully raise the specter of firm failure in the future, why is it that we do not see signs of financial distress in the post-buyback period? One possibility might be that these buyback firms, particularly those categorized as Z1, are issuing shares via seasoned equity offerings in the post-announcement period. If so, rational managers seeking to keep their firms away from bankruptcy may be pre-emptively issuing stock, thus improving their liquidity, their leverage and lowering their

risk of financial distress. In essence, these firms are unwinding whatever harm might have been caused through previously buying back stock.

As a check, we show the frequency of a seasoned equity offering subsequent to a buyback announcement for our sample overall and by Z grouping. In Table 23, we find little evidence of this kind of strategic behavior. Viewed in absolute terms, it is true that we see more SEOs subsequent to a buyback announcement in Z1 firms compared to Z5 firms. For example, after three years we see that Z1 buyback companies are more than twice as likely to have an SEO (10.50%) versus Z5 companies (4.05%). However, it is interesting to note that these trends contrast sharply with the matching control firms. For example, roughly half of the control firms (47.49%) matched against the Z1 firms in our sample had an SEO in the post-announcement period. This compares to only 10.50% for sample firms over the same period. This is consistent with the hypothesis that the buyback firms are reluctant to issue equity because they believe they are undervalued.

Relative to other buyback firms who have little exposure to financial distress, the Z5 firms in our sample do tend to issue stock a little less frequently. The extent of this activity is dwarfed by the issuing activity of control firms with similar firm characteristics and z scores who chose not to announce a buyback at that time. In sum, there is little evidence to suggest that buyback firms are using equity markets to "unravel" any mistakes that might have been caused by a buyback.

11. Summary and Conclusions.

In this paper we examine the consequences of share buybacks of zombie firms, firms in financial distress with low Alman Z-scores. Buybacks made these firms seem at first sight not motivated by maximizing shareholder value. For these firms, common reasons we often see for motivating a buyback do not apply. For example, low z-score firms seemingly have little reason to increase their leverage to enhance corporate tax savings or little need to eliminate agency costs of free cash flow – their situation is comparatively tight. These buybacks are more likely driven by the bad motivations pointed out by the opponents of buybacks: stock price manipulation or the desire to expropriate wealth from other stakeholders such as bondholders and workers.

However, using a sample of matching firms with the same Z-scores and other characteristics that have proven to be correlated with long-term stock returns, buyback firms beat their matching firms both in the short as well as the long run, inconsistent with the stock price manipulation hypothesis. Rather, distressed firms buy back stock because they are undervalued and, despite their poor financial health, have .expropriation of other stakeholders such as bondholders and workers.

A common critique of buybacks is they divert capital away from socially beneficial projects. We find this not to be the case. Repurchasing firms do *not* invest less than their matching counterparts. In the years after the repurchase, return on assets for buyback firms is systematically higher than that of the control firms. This is again consistent with the idea that buybacks on average are not causing social harm but instead are allowing for optimal investment while enabling managers to capitalize on what they perceive as under-valuation. Clearly, the evidence we report is inconsistent with the common critique that buybacks occur at the expense of profitable investment opportunities.

We find no evidence that in general bankruptcies are associated with buyback frequency. Buybacks are not associated with reckless behavior of managers who repurchase stock when they otherwise should not. Distress is mainly a result of other factors such as decline in profitability, sales growth and general increases in leverage unrelated to buybacks.

The fact that we don't find evidence of "bad" behavior in a sample of firms where such behavior is more likely provides additional evidence that the critique of the opponents of buybacks is not consistent with the facts.

On a more general level our result support the relevance of information asymmetries when firms make capital structure decisions as implied by the pecking order theory of Myers and Majluf (1994). When firms are undervalued, they will deviate from the static trade-off theory that predicts that firms with high expected costs of financial distress should have less debt and issue equity rather than repurchase stock.

Bibliography

[1]   Almeida Heitor, Vyacheslav Fos and Mathias Kronlund. 2016." The Real Effects of Share Repurchases". *Journal of Financial Economics* 199 (1) 168-185

[2]   Adalet McGowan, Müge, Dan Andrews, and Valentine Millot. 2018. "The Walking Dead? Zombie Firms and Productivity Performance in OECD Countries." *Economic Policy* 33 (96): 685–736. https://doi.org/10.1093/epolic/eiy012.

[3]   Alderson, Michael J., Joseph T. Halford, and Valeriy Sibilkov. 2020. "An Examination of the Wealth Effects of Share Repurchases on Bondholders." *Journal of Corporate Finance* 65 (December): 101499. https://doi.org/10.1016/j.jcorpfin.2019.101499.

[4]   Altman, Edward I. 1968. "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy." *The Journal of Finance* 23 (4): 589–609. https://doi.org/10.2307/2978933.

[5]   ———. 2018. "A Fifty-Year Retrospective on Credit Risk Models, the Altman Z -Score Family of Models and Their Applications to Financial Markets and Managerial Strategies." *The Journal of Credit Risk* 14 (4): 1–34. https://doi.org/10.21314/JCR.2018.243.

[6]   Altman, Edward I., Rui Dai, and Wei Wang. 2021. "Global Zombies." *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3970332.

[7]   Banerjee, Ryan, and Boris Hofmann. 2018. "The Rise of Zombie Firms: Causes and Consequences," 12.

[8]   ———. 2022. "Corporate Zombies: Anatomy and Life Cycle." *Economic Policy* 37 (112): 757–803. https://doi.org/10.1093/epolic/eiac027.

[9]   Brav, Alon, John R. Graham, Campbell R. Harvey, and Roni Michaely. 2005. "Payout Policy in the 21st Century." *Journal of Financial Economics* 77 (3): 483–527. https://doi.org/10.1016/j.jfineco.2004.07.004.

[10]   Caballero, Ricardo J., Takeo Hoshi, and Anil K. Kashyap. 2008. "Zombie Lending and Depressed Restructuring in Japan." *American Economic Review* 98 (5): 1943–77. https://doi.org/10.1257/aer.98.5.1943.

[11]   Caton, Gary L., Jeremy Goh, Yen Teik Lee, and Scott C. Linn. 2016. "Governance and Post-Repurchase Performance." *Journal of Corporate Finance* 39 (August): 155–73. https://doi.org/10.1016/j.jcorpfin.2016.02.005.

[12]   Chan, Konan, David Ikenberry, and Inmoo Lee. 2004. "Economic Sources of Gain in Stock Repurchases." *Journal of Financial and Quantitative Analysis* 39 (3): 461–79. https://doi.org/10.1017/S0022109000003987.

[13]   Chen, Sheng-Syan, and Yanzhi Wang. 2012. "Financial Constraints and Share Repurchases." *Journal of Financial Economics* 105 (2): 311–31. https://doi.org/10.1016/j.jfineco.2012.03.003.

[14]   Cheng, Yingmei, Jarrad Harford, and Tianming (Tim) Zhang. 2015. "Bonus-Driven Repurchases." *Journal of Financial and Quantitative Analysis* 50 (3): 447–75. https://doi.org/10.1017/S0022109015000149.

[15]   Cziraki, Peter, Evgeny Lyandres, and Roni Michaely. 2021. "What Do Insiders Know? Evidence from Insider Trading around Share Repurchases and SEOs." *Journal of Corporate Finance* 66 (February): 101544. https://doi.org/10.1016/j.jcorpfin.2019.101544.

[16]   Dann, Larry Y. 1981. "Common Stock Repurchases: An Analysis of Returns to Bondholders and Stockholders." *Journal of Financial Economics* 9 (2): 113–38. https://doi.org/10.1016/0304-405X(81)90010-6.

[17]   Evgeniou, Theodoros, Enric Junqué de Fortuny, Nick Nassuphis, and Theo Vermaelen. 2018. "Volatility and the Buyback Anomaly." *Journal of Corporate Finance* 49 (April): 32–53. https://doi.org/10.1016/j.jcorpfin.2017.12.017.

[18]   Evgeniou, Theodoros, and Theo Vermaelen. 2017. "Share Buybacks and Gender Diversity." *Journal of Corporate Finance* 45 (August): 669–86. https://doi.org/10.1016/j.jcorpfin.2017.06.005.

[19]   Fried, Jesse M, and Charles CV Wang. 2018. "Are Buybacks Really Shortchanging Investment?" *Harvard Business Review* 96 (2): 88–95.

[20]   Gong, Guojin, Henock Louis, and Amy X. Sun. 2008. "Earnings Management and Firm Performance Following Open-Market Repurchases." *The Journal of Finance* 63 (2): 947–86. https://doi.org/10.1111/j.1540-6261.2008.01336.x.

[21]   Grullon, Gustavo, and Roni Michaely. 2004. "The Information Content of Share Repurchase Programs." *The Journal of Finance* 59 (2): 651–80. https://doi.org/10.1111/j.1540-6261.2004.00645.x.

[22]   Huang, Sterling, Kaisa Snellman, and Theo Vermaelen. 2022. "Managerial Trustworthiness and Buybacks." *Journal of Financial and Quantitative Analysis* 57 (4): 1454–85. https://doi.org/10.1017/S0022109021000351.

[23]   Ikenberry, David, Josef Lakonishok, and Theo Vermaelen. 1995. "Market Underreaction to Open Market Share Repurchases." *Journal of Financial Economics* 39 (2): 181–208. https://doi.org/10.1016/0304-405X(95)00826-Z.

[24]   ———. 2000. "Stock Repurchases in Canada: Performance and Strategic Trading." *The Journal of Finance* 55 (5): 2373–97. https://doi.org/10.1111/0022-1082.00291.

[25]   Jensen, Michael C. 1986. "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers." *The American Economic Review* 76 (2): 323–29.

[26]   Kahle, Kathleen M. 2002. "When a Buyback Isn't a Buyback: Open Market Repurchases and Employee Options." *Journal of Financial Economics* 63 (2): 235–61. https://doi.org/10.1016/S0304-405X(01)00095-2.

[27]   Lee, Inmoo, Yuen Jung Park, and Neil D. Pearson. 2020. "Repurchases after Being Well Known as Good News." *Journal of Corporate Finance* 62 (June): 101552. https://doi.org/10.1016/j.jcorpfin.2019.101552.

[28]   Liang, Woan-lih. 2016. "Sensitivity to Investor Sentiment and Stock Performance of Open Market Share Repurchases." *Journal of Banking & Finance* 71 (October): 75–94. https://doi.org/10.1016/j.jbankfin.2016.06.003.

[29]   Lie, Erik. 2005. "Operating Performance Following Open Market Share Repurchase Announcements." *Journal of Accounting and Economics* 39 (3): 411–36. https://doi.org/10.1016/j.jacceco.2005.04.001.

[30]   Manconi, Alberto, Urs Peyer, and Theo Vermaelen. 2019. "Are Buybacks Good for Long-Term Shareholder Value? Evidence from Buybacks around the World." *Journal of Financial and Quantitative Analysis* 54 (5): 1899–1935. https://doi.org/10.1017/S0022109018000984.

[31]   Myers, Stewart C. 1977. "Determinants of Corporate Borrowing." *Journal of Financial Economics* 5 (2): 147–75. https://doi.org/10.1016/0304-405X(77)90015-0.

[32]   Myers, Stewart C., and Nicholas S. Majluf. 1984. "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have." *Journal of Financial Economics* 13 (2): 187–221. https://doi.org/10.1016/0304-405X(84)90023-0.

[33]   Peyer, Urs, and Theo Vermaelen. 2009. "The Nature and Persistence of Buyback Anomalies." *The Review of Financial Studies* 22 (4): 1693–1745. https://doi.org/10.1093/rfs/hhn024.

[34]   Schivardi, Fabiano, Enrico Sette, and Guido Tabellini. 2022. "Credit Misallocation During the European Financial Crisis." *The Economic Journal* 132 (641): 391–423. https://doi.org/10.1093/ej/ueab039.

[35]   Stephens, Clifford P., and Michael S. Weisbach. 1998. "Actual Share Reacquisitions in Open-Market Repurchase Programs." *The Journal of Finance* 53 (1): 313–33. https://doi.org/10.1111/0022-1082.115194.

[36]   Storz, Manuela, Michael Koetter, Ralph Setzer, and Andreas Westphal. 2017. "Do We Want These Two to Tango? On Zombie Firms and Stressed Banks in Europe."

[37]   Vermaelen, Theo. 1981. "Common Stock Repurchases and Market Signalling: An Empirical Study." *Journal of Financial Economics* 9 (2): 139–83. https://doi.org/10.1016/0304-405X(81)90011-8.

[38]   Wang, Zigan, Qie Ellie Yin, and Luping Yu. 2021. "Real Effects of Share Repurchases Legalization on Corporate Behaviors." *Journal of Financial Economics* 140 (1): 197–219. https://doi.org/10.1016/j.jfineco.2020.10.008.

Tables and Figures

Table 1 Bankruptcy Frequency Across Z Scores

This table displays the likelihood of firms declaring bankruptcy within a three-year period following each July. It encompasses all firms listed in the CRSP database, with the exception of financial institutions (SIC codes 6000-6799), public administrations (SIC codes 9100-9999), and public utilities (SIC codes 4900-4999). This inclusion is broader than merely buyback companies. The numerator in this probability ratio represents the total count of firms that have filed for Chapter 7 or 11 bankruptcy within the three years post each July. The denominator pertains to the total number of firms each July with available Z-scores and corresponding Z quintile groupings. Data concerning bankruptcy filings is sourced from the Audit Analytics Database. Firms denoted as $Z_{<1.8}$ have a Z-Score less than 1.8.

Year	$Z_{<1.8}$	Z1 Low	Z1 Medium	Z1 High	Z1	Z2	Z3	Z4	Z5
1999	3.37%	4.44%	2.29%	0.67%	2.90%	0.99%	0.90%	0.20%	0.00%
2000	4.53%	4.55%	6.67%	0.87%	4.27%	0.28%	1.48%	0.21%	0.20%
2001	3.85%	4.92%	2.26%	2.38%	3.72%	0.28%	0.00%	0.45%	0.00%
2002	2.17%	2.35%	4.00%	0.00%	2.20%	0.00%	0.00%	0.21%	0.12%
2003	1.12%	1.19%	0.84%	0.78%	1.05%	0.55%	0.56%	0.00%	0.28%
2004	1.41%	0.96%	2.26%	1.15%	1.32%	0.57%	0.29%	0.00%	0.23%
2005	1.22%	0.96%	1.67%	0.00%	0.93%	0.94%	0.27%	0.00%	0.00%
2006	2.77%	2.48%	3.33%	2.15%	2.62%	0.62%	0.29%	0.48%	0.00%
2007	3.47%	3.74%	2.86%	1.04%	3.07%	0.62%	0.57%	0.00%	0.13%
2008	3.35%	4.04%	2.97%	0.00%	2.97%	0.31%	0.59%	0.00%	0.00%
2009	0.91%	1.60%	0.00%	0.00%	0.97%	0.28%	0.00%	0.00%	0.00%
2010	0.69%	1.29%	0.00%	0.00%	0.73%	0.30%	0.00%	0.00%	0.00%
2011	1.08%	1.00%	1.98%	0.00%	0.98%	0.32%	0.00%	0.00%	0.00%
2012	0.61%	1.00%	0.00%	0.00%	0.61%	0.74%	0.00%	0.00%	0.00%
2013	2.28%	3.19%	1.72%	0.00%	2.17%	0.35%	0.00%	0.30%	0.00%
2014	2.59%	3.75%	0.97%	0.85%	2.46%	0.71%	0.33%	0.00%	0.19%
2015	2.42%	3.82%	0.00%	0.92%	2.32%	0.34%	0.00%	0.00%	0.18%
2016	0.78%	0.80%	0.90%	1.04%	0.88%	0.36%	0.36%	0.00%	0.37%
2017	1.15%	1.48%	0.00%	2.11%	1.30%	0.00%	0.36%	0.00%	0.20%
2018	2.10%	2.75%	0.96%	1.16%	2.02%	0.38%	0.38%	0.00%	0.00%
Average	2.09%	2.51%	1.78%	0.76%	1.97%	0.45%	0.32%	0.09%	0.09%

Median Z Score and Z1/Z5 Cutoff Score over Time
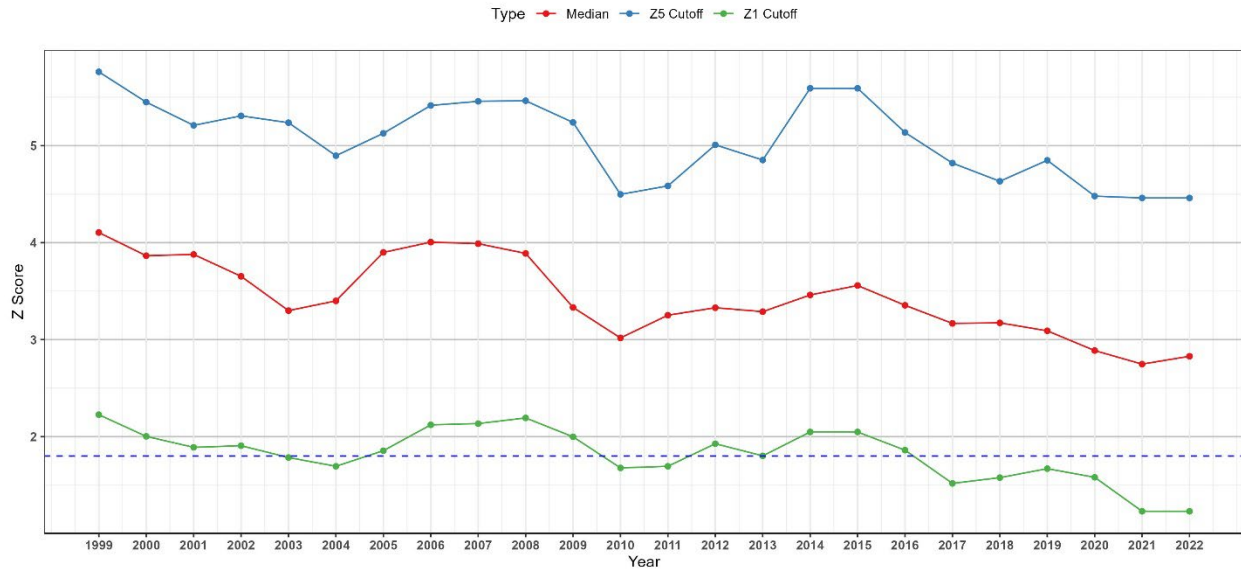
Figure 1 Median Z Score and Z1/Z5 Cutoff Score over Time
This figure illustrates the evolution of the median Z-Score and the boundaries for the Z1/Z5 cutoff scores over time. Firms with a Z-Score falling below the green line are categorized into the Z1 group, while those surpassing the blue line are classified into the Z5 group. The blue dashed line denotes a Z-Score of 1.8. The sample encompasses all firms listed in the CRSP database, with the exception of financial institutions (SIC codes 6000-6799), public administrations (SIC codes 9100-9999), and public utilities (SIC codes 4900-4999).

Table 2 Median Z Scores over Time

This table reports the median Z scores and cut-offs for the Z1 and Z5 groups. Companies with a Z score lower than the Z1 cut-off are classified into the Z1 group, while those with a Z score higher than the Z5 cut-off are classified into the Z5 group. The sample encompasses all firms listed in the CRSP database, with the exception of financial institutions (SIC codes 6000-6799), public administrations (SIC codes 9100-9999), and public utilities (SIC codes 4900-4999).

Year	Median	Z1 Cutoff	Z5 Cutoff	Year	Median	Z1 Cutoff	Z5 Cutoff
1999	4.10	2.23	5.76	2011	3.25	1.69	4.59
2000	3.87	2.00	5.45	2012	3.33	1.93	5.01
2001	3.88	1.89	5.21	2013	3.29	1.80	4.85
2002	3.65	1.91	5.31	2014	3.46	2.05	5.59
2003	3.30	1.79	5.24	2015	3.56	2.05	5.59
2004	3.40	1.69	4.90	2016	3.35	1.86	5.14
2005	3.90	1.86	5.13	2017	3.17	1.52	4.82
2006	4.01	2.12	5.41	2018	3.17	1.58	4.63
2007	3.99	2.13	5.46	2019	3.09	1.67	4.85
2008	3.89	2.19	5.46	2020	2.89	1.58	4.48
2009	3.33	2.00	5.24	2021	2.75	1.23	4.46
2010	3.02	1.68	4.50	2022	2.83	1.23	4.46
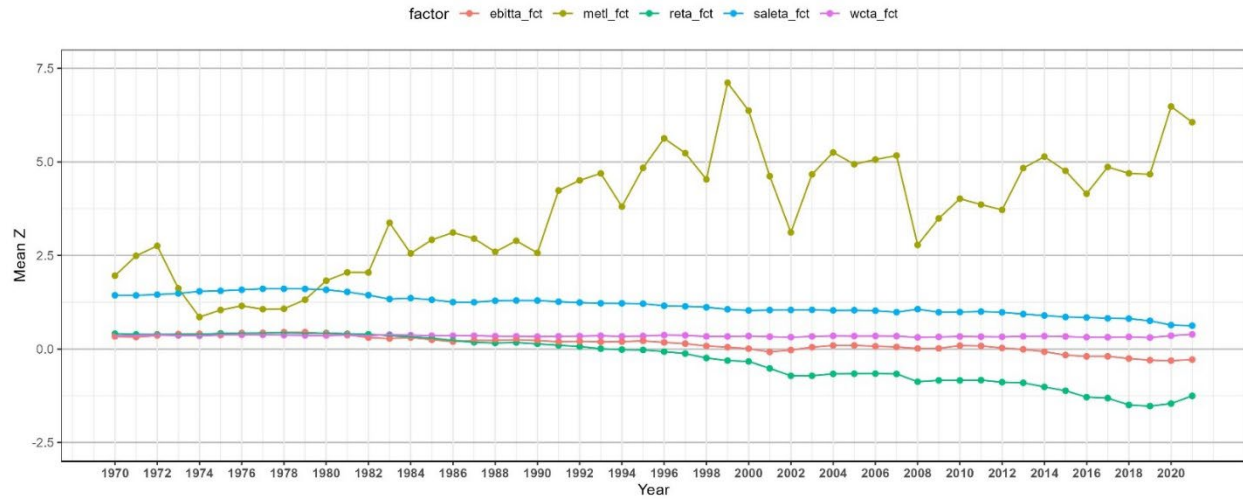
Figure 2 Decomposition of Z Score Time Series

This figure illustrates the temporal evolution of the five key components in the Z-Score calculation:

$$Z = 1.2 \cdot \frac{Working\ Capital}{Total\ Assets} + 1.4 \cdot \frac{Retained\ Earnings}{Total\ Assets} + 3.3 \cdot \frac{EBIT}{Total\ Asets} + 0.6 \cdot \frac{Market\ Value\ of\ Equity}{Book\ Value\ of\ Total\ Liability} + 0.99$$
$$\cdot \frac{Sales}{Total\ Assets}$$

1. $wcta\_fct$: Working Capital to Total Assets, multiplied by 1.2.
2. $reta\_fct$: Retained Earnings to Total Assets, multiplied by 1.4.
3. $ebitta\_fct$: Earnings Before Interest and Taxes (EBIT) to Total Assets, multiplied by 3.3.
4. $metl\_fct$: Market Value of Equity to Book Value of Total Liabilities, multiplied by 0.6.
5. $saleta\_fct$: Sales to Total Assets, multiplied by 0.99.

Table 3 Matching Performance

This table presents the matching performance of different groups. Variable Size denotes the log of market capitalization (in million), variable BM stands for the book-to-market ratio, and variable prior return is the raw returns in the six months prior to firms repurchase announcement, ending five days before the announcement day. Group 1 denotes the repurchasing firms. Group 2 is the matching firms. Each repurchasing firm corresponds to five matching firms. To assess the quality of this matching, we compute the average of the variables for the five matched firms for each repurchasing firm.

Variable	Group1	Group2	Dif	Mean1	Mean2	N1	N2	t	p
Size	Repurchasing	Matching	0.36***	7.00	6.64	8,380	8,380	12.87	0.00
B/M	Repurchasing	Matching	-0.02***	0.50	0.52	8,380	8,380	-3.64	0.00
Prior Return	Repurchasing	Matching	-0.01	-0.02	-0.02	8,380	8,380	-1.55	0.12
Z-Score	Repurchasing	Matching	-0.07	6.15	6.23	8,380	8,380	-0.72	0.47
FF12 Industry	Repurchasing	Matching	Perfectly Controlled			8,380	8,380		

Table 4 Five-Day Abnormal Returns Following Repurchase Announcements Across Z-Quintile Groups Over Time

This table reports the 5-day abnormal return of repurchase announcements across different Z quintile groups over different time periods. The 5-day time window includes two days before, two days after, and the announcement day. The table provides the abnormal returns of the repurchasing firms over their matching firms along with their t-stats and the number of observations. Panel A delineates the categories based on Z-Quintile distinctions. The labels "Z1-Low", "Z1-Medium", and "Z1-High" represent tripartite divisions within the Z1 group. Panel B shows the categorization based on Z-Scores, specifically those below 1.8 and those 1.8 or above. ∗∗∗, ∗∗, and ∗ indicate that abnormal returns are significant at the 1%, 5%, and 10% significance levels, respectively.

	Full Sample	Different Time Periods						
		1990~1998	1999~2002	2003~2006	2007~2010	2011~2014	2015~2018	2019~2021
Panel A: Categorization using Z-Quintile								
Z1-Low	2.09%***	2.25%**	3.37%*	1.62%	3.44%***	-0.35%	-3.27%	9.87%
	(3.41)	(2.18)	(1.84)	(1.04)	(2.92)	(-0.19)	(-1.48)	(1.70)
	244	86	22	34	49	34	12	7
Z1-Medium	1.58%***	-0.14%	-0.68%	2.40%	5.51%***	2.98%**	1.48%	5.50%*
	(3.27)	(-0.19)	(-0.41)	(1.42)	(3.52)	(2.59)	(1.24)	(2.09)
	294	102	32	28	30	42	47	13
Z1-High	1.19%**	2.32%***	3.19%	1.60%	-1.12%	0.72%	0.53%	1.02%
	(2.59)	(3.18)	(1.46)	(1.59)	(-0.78)	(0.63)	(0.47)	(0.53)
	299	84	22	33	42	46	44	28
Z1	1.59%***	1.38%***	1.61%	1.85%**	2.37%***	1.20%	0.52%	3.52%**
	(5.37)	(2.85)	(1.48)	(2.25)	(2.89)	(1.54)	(0.67)	(2.20)
	837	272	76	95	121	122	103	48
Z2	1.87%***	2.69%***	1.61%*	1.17%**	2.69%***	1.14%*	1.18%*	0.62%
	(7.82)	(6.16)	(1.89)	(2.07)	(4.24)	(1.97)	(1.82)	(0.61)
	1,105	340	125	103	158	164	154	61
Z3	1.82%***	2.01%***	3.72%***	0.23%	1.66%***	0.85%**	1.28%*	2.76%***
	(8.35)	(5.26)	(4.72)	(0.48)	(2.67)	(2.14)	(1.90)	(3.15)
	1,452	499	185	128	200	216	149	75
Z4	2.00%***	2.17%***	2.29%***	1.28%**	2.34%***	0.98%**	1.99%***	3.66%***
	(9.64)	(6.13)	(3.33)	(2.12)	(3.89)	(2.39)	(3.12)	(3.41)
	1,749	628	210	190	218	251	160	92
Z5	1.37%***	1.55%***	1.84%***	0.66%*	1.99%***	0.04%	1.22%**	1.81%**
	(8.09)	(5.20)	(3.37)	(1.81)	(4.31)	(0.11)	(2.47)	(2.48)
	3,236	1,179	443	389	501	353	262	109
Z2-Z5	1.68%***	1.93%***	2.27%***	0.81%***	2.10%***	0.64%***	1.39%***	2.31%***
	(16.29)	(10.62)	(6.53)	(3.23)	(7.31)	(2.90)	(4.66)	(4.98)
	7,542	2,646	963	810	1,077	984	725	337
Mean Dif (Z1 − Z2~Z5)	-0.09%	-0.56%	-0.66%	1.04%	0.27%	0.56%	-0.87%	1.21%
	(-0.28)	(-1.08)	(-0.57)	(1.22)	(0.32)	(0.69)	(-1.05)	(0.73)
Overall	1.67%***	1.88%***	2.22%***	0.91%***	2.13%***	0.70%***	1.29%***	2.46%***
	(17.15)	(10.99)	(6.70)	(3.83)	(7.85)	(3.27)	(4.60)	(5.45)
	8,379	2,918	1,039	905	1,198	1,106	828	385
Panel B: Categorization with Z < 1.8 and Z ≥ 1.8								
$Z_{<1.8}$	1.46%***	0.88%	1.42%	2.26%**	3.08%***	0.88%	0.57%	2.40%*
	(4.56)	(1.47)	(1.23)	(2.35)	(3.62)	(1.01)	(0.79)	(1.97)
	727	199	65	74	99	105	116	69
Mean Dif ($Z_{<1.8}$ − $Z_{\geq1.8}$)	-0.22%	-1.07%*	-0.85%	1.47%	1.04%	0.19%	-0.84%	-0.08%
	(-0.66)	(-1.72)	(-0.71)	(1.48)	(1.16)	(0.22)	(-1.07)	(-0.06)

Table 5 BHAR across Different Z Groups and Time Periods

This table reports buy-and-hold abnormal returns across different quintile groups of Z and various holding periods. Z1 is equally divided into three subgroups based on Z-Score: low, medium, and high. If a control firm announces a buyback or is delisted during a specified calculation period, such as a 6-month return, its missing values are substituted by the market value-weighted return (VWRETD). That firm will be excluded from the portfolio in the next holding period. Z2~Z5 represents the aggregate of Z quintile group 2 to 5. Mean Dif $(Z1 - Z2 \sim Z5)$ denotes the mean difference of BHAR between Z1 and the aggregate of Z2 to Z5. Panel A delineates the categories based on Z-Quintile distinctions. Panel B shows the categorization based on Z-Scores, specifically those below 1.8 and those 1.8 or above. Mean Dif $(Z_{<1.8} - Z_{\geq1.8})$ denotes the mean difference of BHAR between groups with Z-Score below 1.8 and those 1.8 or above. Before portfolio formation, returns are winsorized at the 1% and 99% level. *, **, *** represents 10%, 5%, and 1% significance level respectively.

	Buy-and-Hold Abnormal Return					
	3-month	**6-month**	**1-year**	**2-year**	**3-year**	**4-year**
Panel A: Categorization using Z-Quintile						
	1.24%***	1.75%***	2.79%***	3.26%***	4.51%***	9.95%***
Full Sample	(5.74)	(5.46)	(5.26)	(3.36)	(3.67)	(5.98)
	8,377	8,351	8,256	7,861	7,295	6,729
	3.58%**	3.27%	8.28%**	9.74%*	17.97%*	25.98%**
Z1-Low	(2.33)	(1.50)	(2.36)	(1.77)	(1.95)	(1.98)
	244	243	239	226	196	170
	1.60%	0.81%	0.66%	1.82%	6.16%	16.29%
Z1-Medium	(1.43)	(0.51)	(0.26)	(0.43)	(0.97)	(1.52)
	294	294	289	276	249	228
	1.02%	1.04%	2.76%	3.96%	16.48%***	32.79%***
Z1-High	(1.05)	(0.77)	(1.25)	(1.09)	(2.69)	(2.76)
	299	295	293	278	245	222
	1.96%***	1.58%	3.59%**	4.68%*	12.85%***	24.40%***
Z1	(2.86)	(1.64)	(2.31)	(1.84)	(3.14)	(3.60)
	837	832	821	780	690	620
	0.86%*	1.26%	2.24%*	1.47%	0.36%	5.66%
Z2	(1.65)	(1.57)	(1.73)	(0.63)	(0.13)	(1.56)
	1,105	1,098	1,080	1,021	938	855
	1.62%***	2.40%***	3.97%***	4.38%**	4.39%*	6.93%**
Z3	(3.43)	(3.45)	(3.32)	(2.22)	(1.66)	(2.18)
	1,451	1,448	1,424	1,351	1,246	1,136
	1.07%**	1.56%**	3.78%***	6.33%***	7.90%***	14.08%***
Z4	(2.44)	(2.42)	(3.27)	(3.20)	(3.20)	(4.11)
	1,749	1,745	1,730	1,640	1,540	1,432
	1.09%***	1.80%***	1.71%*	1.49%	2.43%	7.75%***
Z5	(2.84)	(3.13)	(1.85)	(0.80)	(1.09)	(2.65)
	3,235	3,227	3,199	3,066	2,877	2,677
	1.15%***	1.76%***	2.69%***	3.08%***	3.61%***	8.48%***
Z2~Z5	(5.07)	(5.19)	(4.77)	(2.96)	(2.80)	(4.99)
	7,540	7,519	7,435	7,081	6,604	6,106
Mean Dif	0.80%	-0.16%	0.91%	1.66%	9.66%**	16.00%**
$(Z1 - Z2 \sim Z5)$	(1.11)	(-0.16)	(0.55)	(0.60)	(2.25)	(2.29)
Panel B: Categorization with Z < 1.8 and Z ≥ 1.8						
	2.54%***	2.19%**	3.86%**	4.13%	11.68%**	19.13%***
$Z_{<1.8}$	(3.46)	(2.03)	(2.23)	(1.41)	(2.55)	(2.75)
	727	722	707	658	587	519
Mean Dif	1.42%*	0.51%	1.21%	1.14%	8.23%*	9.86%
$(Z_{<1.8} - Z_{\geq1.8})$	(1.85)	(0.45)	(0.67)	(0.37)	(1.73)	(1.38)

Notes on addressing missing values during computation.

- If a control firm announces a buyback or is delisted during a specified calculation period, such as a 6-month return, its missing values are substituted by the market value-weighted return (VWRETD).
- Should there be missing values for the 'treat' firm during a calculation period, for instance, a 6-month return, these missing values are replaced by market returns. In subsequent return calculations, such as a 12-month return, both this 'treat' firm and its corresponding control firms are excluded from the sample.

- Observations nearing the end of the sample period are omitted if their projected return timeframe extends beyond the sample's end date.

Table 6 Fama-French IRATS

For every event month, denoted as j, where j=0 represents the month when the open market repurchase is announced, a cross-sectional regression is conducted. The regression involves analyzing the monthly excess returns of buyback firms in the corresponding calendar month, t, for event month j, over the FF5-factors for the same month. The resulting alpha j represents the abnormal returns for each event month j, within a specified time period of (+1, +12). The intercepts obtained from these alpha j values are then summed up to derive the cumulative abnormal return (CAR) figures. The standard error for a given event window is determined by taking the square root of the sum of the squares of the monthly standard errors. Z2~Z5 represents the aggregate of Z quintile group 2 to 5. Mean Difference $(Z1 - Z2$~$Z5)$ denotes the mean difference of alpha j between Z1 and the aggregate of Z2 to Z5. Panel A delineates the categories based on Z-Quintile distinctions. Panel B shows the categorization based on Z-Scores, specifically those below 1.8 and those 1.8 or above. Mean Difference $(Z_{<1.8} - Z_{\geq1.8})$ denotes the mean difference of alpha j between groups with Z-Score below 1.8 and those 1.8 or above. *, **, *** represents 10%, 5%, and 1% significance level respectively.

	Months			
	(+1, +12)	**(+1, +24)**	**(+1, +36)**	**(+1, +48)**
Panel A: Categorization using Z-Quintile				
Full Sample	3.38%***	7.65%***	10.68%***	14.70%***
	(7.12)	(10.66)	(11.99)	(14.00)
Z1-Low	5.71%	8.90%*	17.53%**	22.43%***
	(1.49)	(1.66)	(2.56)	(2.83)
Z1-Medium	-0.69%	-0.17%	1.99%	9.84%
	(-0.28)	(-0.05)	(0.44)	(1.61)
Z1-High	1.43%	7.40%**	17.59%***	20.60%***
	(0.66)	(2.18)	(4.19)	(4.09)
Z1	1.69%	4.91%**	11.14%***	16.81%***
	(1.06)	(2.12)	(3.84)	(4.66)
Z2	0.94%	2.54%	3.62%	5.81%**
	(0.81)	(1.48)	(1.61)	(2.16)
Z3	4.32%***	10.42%***	11.57%***	14.21%***
	(4.10)	(5.59)	(5.28)	(5.67)
Z4	3.96%***	8.24%***	10.54%***	14.52%***
	(3.98)	(5.72)	(5.90)	(6.83)
Z5	4.17%***	8.92%***	13.25%***	18.15%***
	(5.12)	(7.36)	(8.77)	(10.29)
Z2~Z5	3.64%***	8.02%***	10.76%***	14.62%***
	(7.33)	(10.67)	(11.52)	(13.35)
Mean Difference	-0.16%	-0.13%	0.01%	0.05%
$(Z1 - Z2$~$Z5)$	(-1.34)	(-1.38)	(0.12)	(0.55)
Panel B: Categorization with Z < 1.8 and Z ≥ 1.8				
$Z_{<1.8}$	1.83%	4.44%*	10.27%***	15.11%***
	(1.05)	(1.77)	(3.28)	(3.90)
Mean Difference	-0.15%	-0.15%*	-0.02%	0.01%
$(Z_{<1.8} - Z_{\geq1.8})$	(-1.19)	(-1.78)	(-0.19)	(0.09)

Table 7 Funding Source of Buyback Events First Fiscal Year Following the Buyback Announcements

This table reports the funding sources of buyback events over the Z quintile groups. The variables are based on the combined data from the fiscal year of the announcement and the subsequent fiscal year, representing a two-year sum. "Earning" is defined as the sum of Income Before Extraordinary Items (Compustat Item 123), Depreciation and Amortization (Item 125), and Extraordinary Items and Discontinued Operations (Item 124); "F.other" as the sum of Deferred Taxes (Item 126), Equity in Net Loss (Earnings) (Item 106), and Funds from Operations – Other (Item 217); "Invsale.net" as the net sale of investment, calculated by Sale of Investments (Item 109) – Increase in Investments (Item 113); "Dlt.net" as the net of long-term debt issuance, calculated by Long-Term Debt – Issuance (Item 111) – Long-Term Debt – Reduction (Item 114); "Sstk.net" as net sale of common and preferred stock, calculated by Sale of Common and Preferred Stock (Item 108) – Purchase of Common and Preferred Stock (Item 115); "Sppe" as sale of property, plant and equipment (Item 107) + Sale of Property, Plant, and Equipment and Sale of Investments – Loss(Gain) (Item 213). "Dlcch" represents Change in Current Debt (Item 301). "Capx" denotes Capital Expenditures (Item 128). "Dv" represents Cash Dividends (Item 127). "Aqc" represents Acquisitions (Item 129). "Chech" represents Cash and Cash Equivalents – Increase(Decrease) (Item 274). "ϵ" represents residuals to make the accounting identity equation holds, which is the sum of the Source of Funds – Other (Item 218), Uses of Funds – Other (Item 219), and Working Capital Change – Other – Increase (Decrease) (Item 236). The cash identity equation is as follows:

$$(Earning + F.other + Invsale.net + Dlt.net + Sppe + Sstk.net + Dlcch) - (Capx + Dv + Aqc) + \epsilon = Chech$$

"dif" is the difference between the left-hand side and right-hand side of the above equation. All variables are normalized by the firm's average total assets, calculated from the beginning and end of the fiscal year when the announcements occurred. Panel A presents the funding source decomposition. Panel B presents the mean difference between repurchasing firms and matching firms. *, **, *** represents 10%, 5%, and 1% significance level respectively.

Panel A: Funding Source Decomposition

Group	Treatment	N	Earning	F.other	Invsale.net	Dlt.net	Sppe	Sstk.net	Dlcch	Capx	Dv	Aqc	ϵ	Chech	dif
Full Sample	Repurchasing	2,836	23.41%	4.18%	-0.12%	4.37%	0.99%	-8.31%	0.60%	12.19%	2.71%	6.97%	-2.04%	1.21%	0.00%
	Matching	2,836	12.78%	6.40%	-0.66%	4.42%	0.79%	4.27%	0.78%	13.03%	2.34%	7.48%	-3.40%	2.52%	0.00%
Z1-Low	Repurchasing	55	13.93%	6.60%	2.36%	7.29%	3.96%	2.23%	0.90%	20.52%	1.99%	4.97%	-4.18%	5.60%	0.00%
	Matching	55	0.69%	7.97%	1.02%	3.72%	2.73%	9.37%	4.10%	19.33%	0.76%	6.20%	-1.91%	1.41%	0.00%
Z1-Medium	Repurchasing	76	19.22%	4.35%	-0.43%	2.84%	4.10%	-2.70%	-0.05%	18.20%	1.18%	4.62%	-1.23%	2.10%	0.00%
	Matching	76	10.11%	3.10%	0.13%	6.20%	1.46%	7.54%	0.65%	15.13%	0.51%	6.68%	-4.91%	1.94%	0.00%
Z1-High	Repurchasing	70	20.46%	2.91%	1.33%	5.79%	3.24%	-4.92%	0.81%	14.80%	1.70%	9.31%	-4.62%	-0.81%	0.00%
	Matching	70	7.84%	5.60%	0.32%	5.54%	1.49%	2.65%	0.94%	16.85%	1.27%	5.63%	-0.38%	0.26%	0.00%
Z1	Repurchasing	201	18.20%	4.46%	0.95%	5.08%	3.76%	-2.13%	0.51%	17.65%	1.58%	6.35%	-3.22%	2.04%	0.00%
	Matching	201	6.74%	5.30%	0.44%	5.29%	1.82%	6.34%	1.69%	16.88%	0.84%	6.18%	-2.51%	1.21%	0.00%
Z2	Repurchasing	255	17.69%	4.57%	0.12%	4.66%	1.46%	-6.03%	0.00%	12.61%	1.69%	7.53%	-0.80%	-0.16%	0.00%
	Matching	255	1.00%	16.04%	-0.52%	2.95%	1.07%	2.25%	0.33%	11.75%	1.62%	6.39%	-1.37%	1.98%	0.00%
Z3	Repurchasing	357	18.89%	4.01%	0.48%	3.99%	1.22%	-5.84%	0.16%	12.09%	2.35%	6.18%	-1.05%	1.24%	0.00%
	Matching	357	13.51%	4.15%	-0.39%	3.15%	0.83%	0.97%	0.47%	12.25%	1.73%	6.94%	-1.15%	0.62%	0.00%
Z4	Repurchasing	580	22.30%	3.39%	-0.43%	4.69%	0.92%	-6.60%	0.69%	11.51%	2.32%	7.27%	-2.52%	1.32%	0.00%
	Matching	580	15.00%	5.86%	-0.64%	5.17%	0.82%	2.57%	0.83%	12.96%	2.06%	8.79%	-3.18%	2.63%	0.00%
Z5	Repurchasing	1,443	26.71%	4.44%	-0.33%	4.18%	0.50%	-10.88%	0.78%	11.64%	3.29%	7.04%	-2.14%	1.29%	0.00%
	Matching	1,443	14.62%	5.62%	-0.92%	4.58%	0.57%	5.83%	0.78%	12.94%	2.93%	7.46%	-4.53%	3.23%	0.00%
Z2~Z5	Repurchasing	2,635	23.80%	4.16%	-0.20%	4.31%	0.78%	-8.79%	0.60%	11.77%	2.79%	7.02%	-1.95%	1.15%	0.00%
	Matching	2,635	13.24%	6.48%	-0.75%	4.36%	0.71%	4.11%	0.71%	12.74%	2.45%	7.58%	-3.47%	2.62%	0.00%
$Z_{<1.8}$	Repurchasing	168	18.64%	4.27%	0.53%	5.04%	3.55%	-2.20%	0.43%	17.51%	1.61%	6.07%	-1.76%	3.32%	0.00%
	Matching	168	6.33%	5.40%	0.63%	4.46%	1.78%	7.36%	1.50%	15.92%	0.68%	6.69%	-2.52%	1.66%	0.00%
$Z_{\geq1.8}$	Repurchasing	2,668	23.71%	4.18%	-0.16%	4.32%	0.83%	-8.70%	0.61%	11.85%	2.78%	7.03%	-2.05%	1.08%	0.00%
	Matching	2,668	13.18%	6.46%	-0.74%	4.42%	0.72%	4.07%	0.73%	12.85%	2.44%	7.53%	-3.46%	2.58%	0.00%

Panel B: Mean Difference of Funding Source (Repurchasing – Matching)

Group	N	Earning	F.other	Invsale.net	Dlt.net	Sppe	Sstk.net	Dlcch	Capx	Dv	Aqc	ϵ	Chech
Full Sample	2,836	10.63%***	-2.22%**	0.55%**	-0.06%	0.21%***	-12.58%***	-0.18%	-0.84%***	0.37%***	-0.51%	1.37%***	-1.31%***

39

	N												
		(9.18)	(-2.12)	(2.23)	(-0.16)	(2.79)	(-22.14)	(-1.27)	(-3.24)	(2.62)	(-1.36)	(3.46)	(-3.82)
Z1-Low	55	13.24%**	-1.37%	1.34%	3.57%	1.22%	-7.14%*	-3.20%	1.19%	1.23%	-1.23%	-2.27%	4.20%
		(2.47)	(-0.74)	(0.88)	(0.88)	(0.83)	(-1.99)	(-1.06)	(0.45)	(0.81)	(-0.44)	(-0.90)	(1.47)
Z1-Medium	76	9.11%***	1.25%	-0.56%	-3.36%	2.64%***	-10.24%***	-0.69%	3.07%	0.67%***	-2.06%	3.68%**	0.15%
		(2.88)	(0.96)	(-0.69)	(-1.60)	(3.20)	(-2.95)	(-1.11)	(1.37)	(3.08)	(-1.05)	(2.32)	(0.07)
Z1-High	70	12.62%***	-2.69%**	1.01%	0.24%	1.75%**	-7.57%***	-0.13%	-2.05%	0.43%	3.67%	-4.25%*	-1.07%
		(3.70)	(-2.36)	(0.56)	(0.06)	(2.12)	(-4.12)	(-0.10)	(-0.92)	(1.14)	(0.89)	(-1.86)	(-0.83)
Z1	201	11.46%***	-0.84%	0.51%	-0.21%	1.94%***	-8.46%***	-1.18%	0.77%	0.74%*	0.16%	-0.71%	0.83%
		(5.15)	(-1.03)	(0.63)	(-0.11)	(3.33)	(-4.82)	(-1.23)	(0.57)	(1.69)	(0.09)	(-0.57)	(0.67)
Z2	255	16.69%	-11.47%	0.64%	1.71%	0.39%	-8.29%***	-0.32%	0.86%	0.07%	1.14%	0.57%	-2.14%**
		(1.54)	(-1.06)	(1.29)	(1.23)	(1.26)	(-7.45)	(-0.77)	(0.87)	(0.15)	(0.88)	(0.60)	(-2.53)
Z3	357	5.38%***	-0.14%	0.87%**	0.84%	0.38%*	-6.81%***	-0.31%	-0.16%	0.62%	-0.77%	0.10%	0.61%
		(4.23)	(-0.21)	(2.47)	(0.85)	(1.78)	(-7.25)	(-0.83)	(-0.22)	(1.21)	(-1.01)	(0.09)	(1.03)
Z4	580	7.30%***	-2.47%	0.22%	-0.48%	0.09%	-9.17%***	-0.15%	-1.45%***	0.27%	-1.52%*	0.65%	-1.31%*
		(3.77)	(-1.56)	(0.34)	(-0.63)	(0.62)	(-5.63)	(-0.50)	(-2.61)	(1.46)	(-1.72)	(0.71)	(-1.80)
Z5	1,443	12.09%***	-1.18%***	0.59%	-0.40%	-0.06%	-16.71%***	0.00%	-1.29%***	0.36%*	-0.42%	2.40%***	-1.94%***
		(14.13)	(-3.68)	(1.58)	(-0.84)	(-0.91)	(-20.86)	(-0.01)	(-3.88)	(1.65)	(-0.82)	(4.18)	(-3.58)
Z2~Z5	2,635	10.57%***	-2.32%**	0.55%**	-0.05%	0.08%	-12.90%***	-0.11%	-0.97%***	0.34%**	-0.56%	1.52%***	-1.48%***
		(8.56)	(-2.07)	(2.14)	(-0.13)	(1.14)	(-21.63)	(-0.78)	(-3.72)	(2.31)	(-1.48)	(3.68)	(-4.13)
$Z_{<1.8}$	168	12.31%***	-1.14%	-0.11%	0.58%	1.77%***	-9.56%***	-1.07%	1.59%	0.93%*	-0.62%	0.75%	1.66%
		(5.04)	(-1.20)	(-0.16)	(0.31)	(2.81)	(-4.71)	(-1.03)	(1.06)	(1.80)	(-0.39)	(0.60)	(1.17)
$Z_{\geq 1.8}$	2,668	10.53%***	-2.28%**	0.59%**	-0.10%	0.11%	-12.77%***	-0.13%	-1.00%***	0.34%**	-0.50%	1.40%***	-1.50%***
		(8.62)	(-2.06)	(2.28)	(-0.27)	(1.60)	(-21.64)	(-0.92)	(-3.84)	(2.29)	(-1.30)	(3.41)	(-4.24)

Table 8 Debt / Asset Before and After the Event

This table reports the Debt / Asset for buyback firms and their matching firms across different Z quintile groups and across four years before and after the event. "T+1" denotes one year forward, while "T-1" denotes one year backward. Accounting variables are calculated using Compustat quarterly data, with the quarter in which the event occurs being skipped. The T+1 variable is calculated by utilizing the four consecutive quarters following the event quarter. Debt is calculated as the sum of current liability(dlcq) and long-term liabilities(dlttq). Debt / Asset is defined as $Debt_t/Asset_t$, where t denotes the end quarter of every consecutive four quarters. "Dif" column reports the mean difference between the average post-announcements performance (T+1~T+4) and the average prior-announcements performance (T-4~T-1). Panel B reports the difference between buyback firms and matching firms in the same group and time period. Panel C shows the results of categorization based on Z-Scores, specifically those below 1.8 and those 1.8 or above. All variables are winsorized at 1% and 99% level. *, **, *** represents 10%, 5%, and 1% significance level respectively.

Group	Treatment	T-4	T-3	T-2	T-1	T+1	T+2	T+3	T+4	Dif
Panel A: Debt-to-Asset Ratio										
Z1	Buyback	36.01%	36.77%	36.59%	34.65%	35.09%	35.80%	35.50%	35.54%	-0.84%*
	Matching	30.50%	32.01%	32.84%	32.55%	32.73%	32.51%	32.11%	31.98%	0.38%
Z2	Buyback	28.70%	29.11%	28.96%	27.49%	28.97%	29.09%	29.75%	30.12%	0.60%***
	Matching	28.77%	29.69%	30.23%	29.90%	30.12%	30.23%	29.85%	30.01%	0.83%**
Z3	Buyback	24.65%	24.46%	24.11%	23.44%	25.22%	25.55%	25.76%	25.93%	0.57%***
	Matching	24.91%	25.06%	25.14%	25.26%	25.59%	25.64%	25.65%	25.89%	1.12%***
Z4	Buyback	19.33%	19.26%	18.58%	17.88%	19.97%	21.31%	22.36%	22.92%	1.94%***
	Matching	19.21%	18.94%	18.39%	19.07%	20.26%	20.64%	21.13%	21.43%	2.79%***
Z5	Buyback	9.40%	8.16%	7.36%	8.09%	11.11%	12.51%	13.35%	14.31%	3.09%***
	Matching	11.53%	10.35%	8.88%	10.13%	12.15%	13.00%	13.78%	14.82%	4.24%***
Z2~Z5	Buyback	17.60%	17.02%	16.43%	16.22%	18.54%	19.49%	20.21%	20.81%	2.80%***
	Matching	18.53%	18.08%	17.43%	18.08%	19.29%	19.73%	20.11%	20.66%	1.97%***
Overall	Buyback	19.42%	18.99%	18.46%	18.08%	20.19%	21.08%	21.68%	22.20%	2.44%***
	Matching	19.72%	19.47%	18.98%	19.54%	20.64%	20.97%	21.26%	21.72%	1.81%***
Panel B: Difference between Buyback Firm and Matching Firm										
Z1	Difference	5.48%***	4.74%***	3.73%***	2.06%***	2.33%***	3.26%***	3.38%***	3.55%***	
		(7.86)	(7.18)	(6.31)	(3.46)	(3.57)	(4.64)	(4.50)	(4.40)	
Z2	Difference	-0.06%	-0.56%	-1.26%***	-2.41%***	-1.14%**	-1.11%**	-0.07%	0.14%	
		(-0.12)	(-1.16)	(-2.94)	(-5.65)	(-2.40)	(-2.24)	(-0.14)	(0.25)	
Z3	Difference	-0.26%	-0.60%	-1.04%***	-1.82%***	-0.37%	-0.09%	0.11%	0.04%	
		(-0.61)	(-1.54)	(-2.98)	(-5.10)	(-0.93)	(-0.20)	(0.23)	(0.09)	
Z4	Difference	0.12%	0.32%	0.19%	-1.19%***	-0.28%	0.67%*	1.22%***	1.49%***	
		(0.32)	(0.97)	(0.63)	(-3.92)	(-0.81)	(1.72)	(2.96)	(3.37)	
Z5	Difference	-2.13%***	-2.19%***	-1.52%***	-2.04%***	-1.04%***	-0.49%*	-0.44%	-0.51%	
		(-8.95)	(-10.45)	(-8.08)	(-9.91)	(-3.99)	(-1.70)	(-1.44)	(-1.55)	
Z2~Z5	Difference	-0.93%***	-1.06%***	-0.99%***	-1.86%***	-0.75%***	-0.23%	0.11%	0.16%	
		(-5.36)	(-6.68)	(-7.03)	(-12.68)	(-4.33)	(-1.23)	(0.54)	(0.76)	
Overall	Difference	-0.29%*	-0.48%***	-0.52%***	-1.46%***	-0.44%***	0.11%	0.42%**	0.48%**	
		(-1.69)	(-3.03)	(-3.68)	(-10.06)	(-2.61)	(0.59)	(2.16)	(2.31)	
Panel C: Categorization with Z < 1.8 and Z ≥ 1.8										
$Z_{<1.8}$	Buyback	36.59%	37.97%	37.84%	36.02%	36.29%	36.99%	36.53%	36.38%	-0.77%
	Matching	30.38%	32.20%	33.14%	32.75%	32.88%	32.71%	32.38%	32.18%	0.52%*
$Z_{\geq1.8}$	Buyback	17.80%	17.18%	16.60%	16.36%	18.66%	19.61%	20.34%	20.96%	2.74%***
	Matching	18.70%	18.26%	17.62%	18.27%	19.46%	19.89%	20.26%	20.81%	1.94%***
$Z_{<1.8}$	Difference	6.18%***	5.73%***	4.67%***	3.24%***	3.37%***	4.26%***	4.14%***	4.20%***	
		(8.25)	(8.11)	(7.32)	(4.97)	(4.77)	(5.62)	(5.13)	(4.74)	
$Z_{\geq1.8}$	Difference	-0.90%***	-1.07%***	-1.02%***	-1.91%***	-0.81%***	-0.27%	0.09%	0.16%	
		(-5.25)	(-6.78)	(-7.23)	(-13.15)	(-4.68)	(-1.46)	(0.44)	(0.74)	

Table 9 Dividend / Asset Before and After the Event

This table reports the Dividend / Asset for buyback firms and their matching firms across different Z quintile groups and across four years before and after the event. "T+1" denotes one year forward, while "T-1" denotes one year backward. Accounting variables are calculated using Compustat quarterly data, with the quarter in which the event occurs being skipped. The T+1 variable is calculated by utilizing the four consecutive quarters following the event quarter. Dividend / Asset is defined as $Dividend_{t-3\sim t}/Asset_t$, where t denotes the end quarter of every consecutive four quarters. "Dif" column reports the mean difference between the average post-announcements performance (T+1~T+4) and the average prior-announcements performance (T-4~T-1). Panel B reports the difference between buyback firms and matching firms in the same group and time period. Panel C shows the results of categorization based on Z-Scores, specifically those below 1.8 and those 1.8 or above. All variables are winsorized at 1% and 99% level. *, **, *** represents 10%, 5%, and 1% significance level respectively.

Group	Treatment	T-4	T-3	T-2	T-1	T+1	T+2	T+3	T+4	Dif
Panel A: Dividend-to-Asset Ratio										
Z1	Buyback	0.63%	0.63%	0.63%	0.67%	0.79%	0.74%	0.76%	0.84%	0.12%***
	Matching	0.66%	0.69%	0.65%	0.63%	0.69%	0.74%	0.76%	0.77%	0.07%***
Z2	Buyback	0.89%	0.85%	0.89%	0.89%	0.97%	1.02%	1.01%	1.07%	-0.01%
	Matching	0.97%	0.94%	0.91%	0.86%	0.92%	0.88%	0.90%	0.91%	0.12%***
Z3	Buyback	1.11%	1.07%	1.05%	1.11%	1.21%	1.24%	1.23%	1.30%	-0.02%
	Matching	1.07%	1.04%	0.99%	0.98%	1.01%	1.02%	1.02%	1.07%	0.13%***
Z4	Buyback	1.26%	1.29%	1.30%	1.31%	1.44%	1.46%	1.49%	1.52%	-0.03%**
	Matching	1.26%	1.24%	1.19%	1.13%	1.17%	1.18%	1.19%	1.21%	0.16%***
Z5	Buyback	1.36%	1.44%	1.45%	1.46%	1.54%	1.62%	1.69%	1.74%	0.01%
	Matching	1.33%	1.32%	1.29%	1.23%	1.27%	1.30%	1.32%	1.33%	0.19%***
Z2~Z5	Buyback	1.22%	1.25%	1.26%	1.28%	1.37%	1.42%	1.46%	1.51%	0.16%***
	Matching	1.21%	1.19%	1.16%	1.10%	1.15%	1.16%	1.17%	1.19%	-0.01%
Overall	Buyback	1.16%	1.19%	1.19%	1.22%	1.31%	1.36%	1.39%	1.45%	0.16%***
	Matching	1.15%	1.14%	1.11%	1.06%	1.10%	1.12%	1.14%	1.16%	0.00%
Panel B: Difference between Buyback Firm and Matching Firm										
Z1	Difference	-0.03%	-0.06%	-0.02%	0.05%	0.10%*	0.00%	0.00%	0.07%	
		(-0.61)	(-1.18)	(-0.46)	(0.96)	(1.78)	(-0.01)	(0.01)	(1.03)	
Z2	Difference	-0.08%*	-0.09%**	-0.03%	0.03%	0.05%	0.14%***	0.10%**	0.17%***	
		(-1.73)	(-2.16)	(-0.61)	(0.65)	(1.14)	(2.83)	(2.17)	(3.24)	
Z3	Difference	0.04%	0.03%	0.06%*	0.13%***	0.21%***	0.22%***	0.21%***	0.24%***	
		(0.93)	(0.78)	(1.68)	(3.19)	(4.91)	(4.93)	(4.90)	(4.59)	
Z4	Difference	0.00%	0.06%	0.11%***	0.18%***	0.27%***	0.27%***	0.30%***	0.31%***	
		(0.10)	(1.19)	(2.58)	(4.41)	(6.20)	(5.74)	(6.06)	(5.72)	
Z5	Difference	0.03%	0.12%***	0.15%***	0.24%***	0.27%***	0.32%***	0.37%***	0.41%***	
		(0.69)	(2.70)	(3.48)	(5.72)	(6.30)	(7.05)	(7.62)	(8.15)	
Z2~Z5	Difference	0.01%	0.06%**	0.10%***	0.17%***	0.23%***	0.26%***	0.28%***	0.32%***	
		(0.41)	(2.39)	(4.26)	(7.66)	(9.65)	(10.50)	(10.84)	(11.36)	
Overall	Difference	0.01%	0.05%**	0.09%***	0.16%***	0.21%***	0.24%***	0.26%***	0.30%***	
		(0.28)	(2.08)	(4.07)	(7.67)	(9.79)	(10.25)	(10.55)	(11.27)	
Panel C: Categorization with Z < 1.8 and Z ≥ 1.8										
$Z_{<1.8}$	Buyback	0.59%	0.60%	0.60%	0.58%	0.73%	0.67%	0.69%	0.82%	0.13%***
	Matching	0.69%	0.72%	0.67%	0.64%	0.73%	0.76%	0.78%	0.80%	0.08%***
$Z_{\geq 1.8}$	Buyback	1.21%	1.24%	1.25%	1.28%	1.37%	1.42%	1.45%	1.50%	0.16%***
	Matching	1.20%	1.18%	1.15%	1.10%	1.13%	1.15%	1.17%	1.19%	-0.01%
$Z_{<1.8}$	Difference	-0.10%**	-0.13%**	-0.07%	-0.06%	0.01%	-0.09%	-0.09%	0.02%	
		(-2.06)	(-2.51)	(-1.41)	(-1.38)	(0.11)	(-1.60)	(-1.55)	(0.33)	
$Z_{\geq 1.8}$	Difference	0.02%	0.06%***	0.10%***	0.18%***	0.23%***	0.27%***	0.29%***	0.32%***	
		(0.68)	(2.62)	(4.43)	(8.04)	(10.01)	(10.76)	(11.09)	(11.50)	

Table 10 Comparative Analysis of Z-Score Changes Pre- and Post-Stock Repurchase Announcements Categorized by Quintiles of Outstanding Share Change (6-Month Window)

Panel A of the table presents the change in Z-Score before and after stock repurchase announcements, categorized by quintiles of outstanding share change over a 6-month period. These quintiles are based on the variation in outstanding shares of the repurchasing firms from the announcement day to six months later. "Share Chg 1" denotes the quintile with the least share change, whereas "Share Chg 5" indicates the most. The month of the buyback is marked as 'T0', while 'T+1' denotes one year post-announcement. The B panel reports the difference in Z-Score between buyback firms and matching firms in the same category and timeframe. The Z-Scores are winsorized at the 1% and 99% levels. T-statistics are provided in parentheses. The symbols *, **, and *** denote significance levels at 10%, 5%, and 1%, respectively.

Share Change Quintile	Group	T-4	T-3	T-2	T-1	T0	T+1	T+2	T+3	T+4	Δshare
Panel A: Mean of Z-Score											
Share Chg 1	Buyback	5.57	5.60	5.68	5.64	5.72	5.29	4.62	4.52	4.55	-8.21%
Lowest	Match	5.44	5.43	5.62	5.71	5.79	5.22	4.74	4.73	4.69	2.99%
Share Chg 2	Buyback	5.66	5.61	5.65	5.67	5.67	5.34	4.93	4.77	4.74	-2.89%
	Match	5.67	5.77	5.78	5.83	5.81	5.38	4.96	4.83	4.67	3.20%
Share Chg 3	Buyback	5.62	5.60	5.54	5.69	5.87	5.46	5.20	5.12	5.00	-1.10%
	Match	5.88	5.87	5.91	5.94	5.97	5.50	5.11	4.95	4.94	3.61%
Share Chg 4	Buyback	5.72	6.11	6.17	6.32	6.31	6.01	5.59	5.49	5.35	0.06%
	Match	5.82	6.01	6.22	6.38	6.33	5.72	5.30	5.15	5.06	4.46%
Share Chg 5	Buyback	6.17	6.18	6.18	6.23	6.46	6.39	5.95	5.73	5.60	16.52%
Highest	Match	6.08	6.08	6.17	6.35	6.38	5.94	5.49	5.26	5.11	7.05%
Overall	Buyback	5.74	5.81	5.84	5.91	6.01	5.69	5.26	5.13	5.05	0.88%
	Match	5.77	5.82	5.94	6.04	6.06	5.55	5.12	4.98	4.89	4.26%
Panel B: Difference between Buyback Firm and Matching Firm											
Share Chg 1 Lowest	Difference	0.13	0.17	0.06	-0.07	-0.07	0.07	-0.12	-0.21**	-0.14	
		(0.84)	(1.19)	(0.48)	(-0.73)	(-0.89)	(0.81)	(-1.34)	(-2.04)	(-1.32)	
Share Chg 2	Difference	-0.02	-0.16	-0.13	-0.16	-0.14*	-0.04	-0.03	-0.06	0.07	
		(-0.11)	(-1.26)	(-1.07)	(-1.52)	(-1.75)	(-0.54)	(-0.34)	(-0.60)	(0.62)	
Share Chg 3	Difference	-0.25*	-0.27**	-0.37***	-0.24**	-0.10	-0.03	0.09	0.17	0.06	
		(-1.86)	(-2.16)	(-3.03)	(-2.52)	(-1.20)	(-0.33)	(0.95)	(1.52)	(0.54)	
Share Chg 4	Difference	-0.10	0.10	-0.05	-0.06	-0.02	0.28**	0.29**	0.34***	0.29**	
		(-0.63)	(0.57)	(-0.32)	(-0.50)	(-0.25)	(2.56)	(2.50)	(2.69)	(2.11)	
Share Chg 5 Highest	Difference	0.09	0.10	0.01	-0.13	0.08	0.45***	0.46***	0.47***	0.49***	
		(0.46)	(0.56)	(0.05)	(-0.97)	(0.82)	(3.55)	(3.54)	(3.37)	(3.31)	
Overall	Difference	-0.03	-0.02	-0.10	-0.13***	-0.05	0.15***	0.14***	0.14***	0.15***	
		(-0.48)	(-0.29)	(-1.60)	(-2.65)	(-1.28)	(3.20)	(2.92)	(2.73)	(2.77)	

Table 11 Z-score Change before and after the event across Z-Quintile Groups – Mean version

Panel A of the table reports the mean Z-scores for different Z quintiles before and after the buyback event. The month of the buy-back is indicated by 'T0'. "T+1" indicates one year after the event. The B panel reports the difference between buyback firms and matching firms in the same group and time period. All variables are winsorized at 1% and 99% level. *, **, *** represents 10%, 5%, and 1% significance level respectively.

Group	Treatment	T-4	T-3	T-2	T-1	T0	T+1	T+2	T+3	T+4
Panel A: Mean of Z-Score										
Z1-Low	Buyback Firm	2.26	1.89	1.56	1.01	0.74	1.20	1.29	1.29	1.55
	Matching Firm	3.07	2.70	2.20	1.75	1.33	1.77	1.78	1.71	1.85
Z1-Med	Buyback Firm	1.98	1.91	1.80	1.70	1.40	1.71	1.83	1.88	1.86
	Matching Firm	2.75	2.74	2.62	2.14	1.75	2.01	2.05	2.14	2.15
Z1-High	Buyback Firm	2.26	2.17	1.94	1.81	1.79	2.11	2.13	2.20	2.27
	Matching Firm	3.14	3.08	2.66	2.33	2.01	2.27	2.31	2.27	2.32
Z1	Buyback Firm	2.16	2.00	1.78	1.54	1.35	1.71	1.78	1.84	1.92
	Matching Firm	2.98	2.85	2.51	2.09	1.72	2.03	2.07	2.07	2.13
Z2	Buyback Firm	2.94	2.94	2.76	2.57	2.44	2.68	2.65	2.69	2.70
	Matching Firm	3.38	3.20	3.02	2.81	2.48	2.63	2.62	2.72	2.74
Z3	Buyback Firm	3.91	3.68	3.65	3.43	3.28	3.52	3.47	3.51	3.52
	Matching Firm	4.02	3.90	3.81	3.58	3.31	3.37	3.38	3.42	3.43
Z4	Buyback Firm	4.88	4.83	4.69	4.54	4.41	4.62	4.54	4.47	4.35
	Matching Firm	5.27	5.31	5.20	4.99	4.66	4.60	4.50	4.42	4.42
Z5	Buyback Firm	9.12	9.42	9.65	10.07	10.52	9.28	8.13	7.74	7.54
	Matching Firm	8.58	8.79	9.28	9.89	10.37	8.92	7.78	7.38	7.09
Z2~Z5	Buyback Firm	6.11	6.21	6.27	6.38	6.52	6.13	5.62	5.46	5.36
	Matching Firm	6.07	6.14	6.31	6.47	6.53	5.93	5.44	5.28	5.17
Overall	Buyback Firm	5.73	5.80	5.83	5.90	6.00	5.69	5.26	5.13	5.05
	Matching Firm	5.77	5.82	5.94	6.04	6.05	5.55	5.12	4.98	4.89
Panel B: Difference between Buyback Firm and Matching Firm										
Z1-Low	Difference	-0.80**	-0.80**	-0.64*	-0.74***	-0.59***	-0.56***	-0.50***	-0.41*	-0.30
		(-2.19)	(-2.26)	(-1.92)	(-4.07)	(-3.60)	(-2.97)	(-2.80)	(-1.70)	(-1.08)
Z1-Med	Difference	-0.78***	-0.83***	-0.82***	-0.44***	-0.35***	-0.29***	-0.22**	-0.26*	-0.30**
		(-4.66)	(-4.27)	(-3.96)	(-2.69)	(-11.48)	(-4.33)	(-2.16)	(-1.95)	(-2.23)
Z1-High	Difference	-0.88***	-0.92***	-0.72***	-0.52***	-0.21***	-0.16**	-0.18*	-0.08	-0.05
		(-3.84)	(-4.37)	(-7.41)	(-7.41)	(-2.10)	(-1.80)	(-0.70)	(-0.52)	
Z1	Difference	-0.82***	-0.85***	-0.73***	-0.56***	-0.37***	-0.32***	-0.28***	-0.23***	-0.21**
		(-5.69)	(-5.95)	(-5.71)	(-6.76)	(-7.29)	(-4.94)	(-3.96)	(-2.58)	(-2.13)
Z2	Difference	-0.45***	-0.27***	-0.26***	-0.23***	-0.04**	0.06	0.03	-0.03	-0.04
		(-4.42)	(-2.84)	(-3.24)	(-4.00)	(-2.15)	(1.50)	(0.57)	(-0.54)	(-0.74)
Z3	Difference	-0.12	-0.22**	-0.16**	-0.16***	-0.03**	0.15***	0.10*	0.09	0.09
		(-1.09)	(-2.49)	(-2.01)	(-3.26)	(-2.30)	(3.00)	(1.82)	(1.48)	(1.19)
Z4	Difference	-0.39***	-0.48***	-0.51***	-0.45***	-0.26***	0.02	0.04	0.06	-0.07
		(-3.83)	(-4.89)	(-6.46)	(-7.70)	(-11.24)	(0.35)	(0.63)	(0.82)	(-0.94)
Z5	Difference	0.55***	0.64***	0.36**	0.18	0.14	0.36***	0.35***	0.36***	0.45***
		(3.31)	(4.11)	(2.55)	(1.52)	(1.49)	(3.29)	(3.17)	(2.98)	(3.53)
Z2~Z5	Difference	0.04	0.06	-0.04	-0.09*	-0.01	0.20***	0.18***	0.18***	0.19***
		(0.48)	(0.88)	(-0.57)	(-1.71)	(-0.27)	(3.94)	(3.56)	(3.22)	(3.17)
Overall	Difference	-0.05	-0.03	-0.10*	-0.14***	-0.05	0.15***	0.14***	0.14***	0.15***
		(-0.66)	(-0.38)	(-1.72)	(-2.77)	(-1.25)	(3.20)	(2.95)	(2.76)	(2.79)

Figure 3 Z-score Change before and after the event across Z-Quintile Groups

This figure plots the mean Z-Scores for different Z quintile groups spanning four years before and after the buyback event. Solid dots depict the full sample, hollow dots represent Z1 group, and solid triangles symbolize the combined Z2 to Z5 groups. The color blue represents the buyback sample, while the color red represents their matching sample.

Table 12 Median S&P Credit Ratings across Different Z-Quintile Groups

This table reports the median S&P credit ratings of buyback firms and their matching firms across different Z quintile groups at different time points relative to buyback events. "T0" denotes the month of repurchasing announcement. "T+1" represents one year following the announcement.

Group	Treatment	T-4	T-3	T-2	T-1	T0	T+1	T+2	T+3	T+4
Z1-Low	Buyback Firm	BB-	BB-	BB-	BB-	BB-	BB-	BB	BB	BB
	Matching Firm	BB-	BB-	BB-	BB-	BB-	BB-	BB-	BB	BB
Z1-Med	Buyback Firm	BB	BB+	BB+	BB+	BB+	BB+	BBB-	BBB-	BBB-
	Matching Firm	BB	BB	BB	BB-	BB-	BB	BB	BB	BB
Z1-High	Buyback Firm	BB+	BB+	BB+	BB+	BB+	BBB-	BBB-	BBB-	BBB-
	Matching Firm	BB+	BB	BB	BB	BB	BB	BB	BB+	BB+
Z1	Buyback Firm	BB	BB	BB	BB	BB	BB	BB+	BB+	BB+
	Matching Firm	BB	BB	BB	BB-	BB	BB	BB	BB	BB
Z2	Buyback Firm	BBB	BBB-	BBB-	BBB	BBB	BBB	BBB	BBB	BBB
	Matching Firm	BB+	BB+	BB+	BB+	BB+	BB+	BB+	BB+	BB+
Z3	Buyback Firm	BBB+	BBB	BBB	BBB	BBB	BBB	BBB	BBB	BBB
	Matching Firm	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-
Z4	Buyback Firm	BBB+	BBB	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+
	Matching Firm	BBB	BBB	BBB	BBB	BBB	BBB	BBB	BBB	BBB
Z5	Buyback Firm	A	A	A	A	A	A	A-	A-	A-
	Matching Firm	BBB+	BBB+	BBB+	BBB	BBB	BBB	BBB	BBB	BBB
Z2~Z5	Buyback Firm	BBB+	BBB	BBB	BBB	BBB+	BBB+	BBB+	BBB+	BBB+
	Matching Firm	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-
Overall	Buyback Firm	BBB	BBB	BBB	BBB	BBB	BBB	BBB	BBB	BBB
	Matching Firm	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-

Table 13 Matching Performance of Treatment Firms

This table presents the matching performance of firms that ultimately experienced bankruptcy. Variable BM was constructed using the book equity value for the last fiscal year-end in t-6 and the market capitalization at the end of December of the previous year. The Z-score was derived from the financial data available for the last fiscal year-end in t-6. Firm size (logarithm of market capitalization) was determined at the end of June in fiscal year t-5. The Fama French 12 Industry classification was perfectly matched between the treatment firms and their corresponding matching firms. Group1 represents the sample of matching firms, while group2 comprises the treatment firms. All variables have been winsorized at the 1% and 99% level. The symbols *, **, *** represent 5%, 1%, and 0.1% significance level respectively. Each repurchasing firm corresponds to five matching firms. To assess the quality of this matching, we compute the average of the variables for the five matched firms for each repurchasing firm.

Variable	Group1	Group2	Dif	Mean1	Mean2	N1	N2	t	p
Size	Treatment	Match	-0.05	4.90	4.96	729	729	-0.60	0.55
BM	Treatment	Match	0.08	0.95	0.87	729	729	1.58	0.11
Z-Score	Treatment	Match	-0.08	3.70	3.78	729	729	-0.22	0.83
FF 12 Industry	Treatment	Match	Perfectly matched		-	729	729	-	-
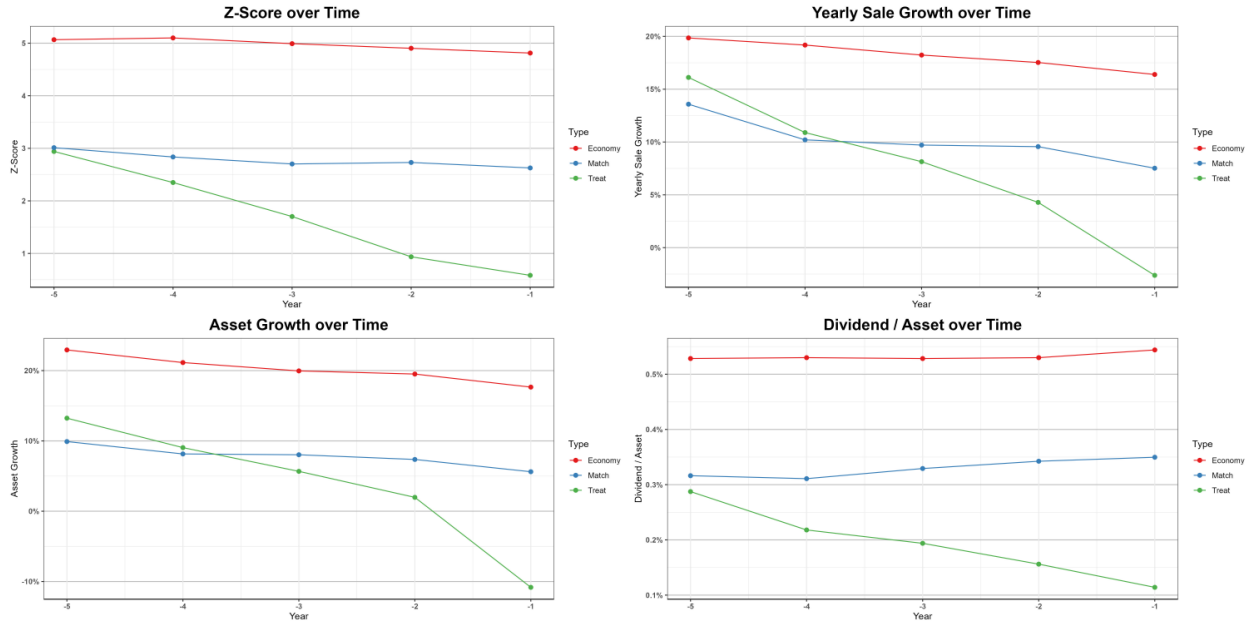
Figure 4 Comparative Analysis of Firm Characteristics over Time across Three Groups – Part 1

This figure presents the time series comparison of firm characteristics for three groups: treatment firms, their matching firms and the entire economy (including all firms in the market). The X-axis represents different fiscal years preceding the bankruptcy filing of treatment firms. Yearly sale growth is calculated as $(sale_t - sale_{t-1})/sale_{t-1}$, where t denotes the fiscal year. Asset growth is defined similarly as $(total\ asset_t - total\ asset_{t-1})/total\ asset_{t-1}$. Dividend/Asset is derived by dividing $dividend_t$ by $total\ asset_t$. Observations with missing values in the dividend variable were excluded. The economy group is depicted by the red line, the matching firm group is represented by the blue line, and the treatment firm group is indicated by the green line.

48

Figure 5 Comparative Analysis of Firm Characteristics over Time across Three Groups – Part 2
This figure provides an extended comparison of firm characteristics among three groups: treatment firms, their matching firms, and the entire economy (including all firms in the market). The X-axis represents different fiscal years preceding the bankruptcy filing of treatment firms. Debt/Asset is derived by dividing $Debt_t$ by TA_t (Total Asset). ROA is defined as $coalesce(Oibdp_t, Sale_t - Xopr_t, Revt_t - Xopr_t)/((TA_{t-1} + TA_t)/2)$, where $Oibdp$ represents operating income before depreciation, $Xopr$ denotes total operating expenses, and $Revt$ represents total revenue. The $coalesce$ function retrieves the first non-missing value from the given parameters. ROE is defined as $coalesce(Oibdp_t, Sale_t - Xopr_t, Revt_t - Xopr_t)/((BE_{t-1} + BE_t)/2)$, where BE represents the book equity value. Total shareholder payout/Asset is defined as $(Dividend_t + Prstkc_t)/TA_t$, where $Prstkc$ denotes the purchase of common and preferred stocks. The economy group is depicted by the red line, the matching firm group is represented by the blue line, and the treatment firm group is indicated by the green line.

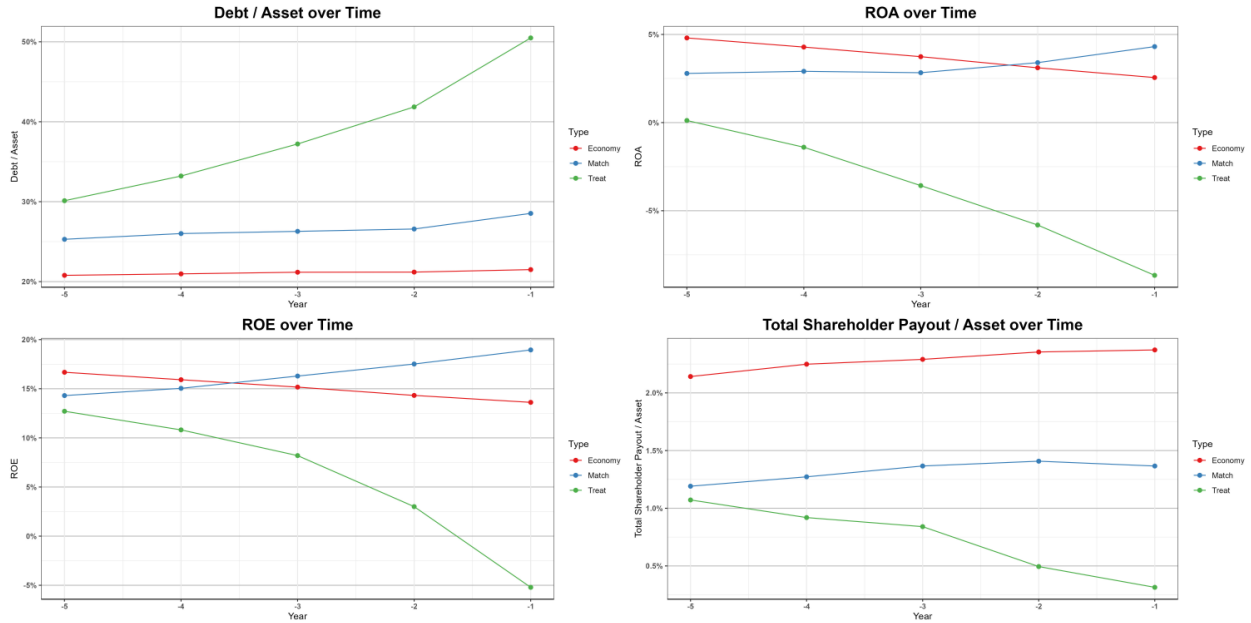# Table 14 Comparative Analysis of Firm Characteristics over Time

This table presents the comparative analysis of firm characteristics for three groups: treatment firms, their matching firms, and the entire economy (including all firms in the market). The "Year" columns indicate the various fiscal years preceding the bankruptcy filing of treatment firms. The "dif" row represents the mean difference between treatment firms and matching firms. The significance levels are denoted by *, **, and *** indicating 10%, 5%, and 1% significance levels, respectively. Yearly sale growth is calculated as $(sale_t - sale_{t-1})/sale_{t-1}$, where t denotes the fiscal year. Asset growth is defined similarly as $(total\ asset_t - total\ asset_{t-1})/total\ asset_{t-1}$. Dividend/Asset is derived by dividing $dividend_t$ by $total\ asset_t$. Debt/Asset is derived by dividing $Debt_t$ by TA_t (Total Asset). ROA is defined as $coalesce(Oibdp_t, Sale_t - Xopr_t, Revt_t - Xopr_t)/((TA_{t-1} + TA_t)/2)$, where $Oibdp$ represents operating income before depreciation, $Xopr$ denotes total operating expenses, and $Revt$ represents total revenue. The $coalesce$ function retrieves the first non-missing value from the given parameters. ROE is defined as $coalesce(Oibdp_t, Sale_t - Xopr_t, Revt_t - Xopr_t)/((BE_{t-1} + BE_t)/2)$, where BE represents the book equity value. Total shareholder payout/Asset is defined as $(Dividend_t + Prstkc_t)/TA_t$, where $Prstkc$ denotes the purchase of common and preferred stocks.

Variable	Group	Year -5	-4	-3	-2	-1	Variable	Group	Year -5	-4	-3	-2	-1
Z	Econ	5.07	5.10	4.99	4.90	4.81	Debt/Asset	Econ	20.79%	20.97%	21.18%	21.19%	21.50%
	Treat	2.94	2.35	1.70	0.94	0.58		Treat	30.12%	33.21%	37.22%	41.85%	50.48%
	Control	3.01	2.84	2.70	2.73	2.63		Control	25.30%	26.01%	26.29%	26.58%	28.54%
	Dif	-0.07	-0.49***	-1.00***	-1.79***	-2.04***		Dif	4.83%***	7.20%***	10.93%***	15.27%***	21.95%***
	t-stat	(-0.40)	(-2.99)	(-6.41)	(-11.97)	(-12.02)		t-stat	(4.89)	(7.00)	(10.15)	(13.45)	(15.98)
Sale Growth	Econ	19.85%	19.18%	18.23%	17.53%	16.39%	ROA	Econ	4.80%	4.28%	3.74%	3.11%	2.55%
	Treat	16.11%	10.90%	8.14%	4.29%	-2.62%		Treat	0.12%	-1.40%	-3.58%	-5.81%	-8.67%
	Control	13.58%	10.21%	9.71%	9.56%	7.52%		Control	2.79%	2.91%	2.83%	3.40%	4.31%
	Dif	2.53%	0.69%	-1.57%	-5.28%***	-10.14%***		Dif	-2.67%***	-4.31%***	-6.40%***	-9.21%***	-12.98%***
	t-stat	(1.61)	(0.45)	(-1.03)	(-3.40)	(-6.27)		t-stat	(-2.82)	(-4.55)	(-6.40)	(-9.13)	(-10.58)
Asset Growth	Econ	22.94%	21.14%	19.96%	19.51%	17.65%	ROE	Econ	16.67%	15.92%	15.16%	14.32%	13.61%
	Treat	13.23%	9.05%	5.67%	1.97%	-10.83%		Treat	12.71%	10.81%	8.20%	3.00%	-5.21%
	Control	9.91%	8.15%	8.03%	7.36%	5.62%		Control	14.30%	15.04%	16.29%	17.52%	18.95%
	Dif	3.33%**	0.90%	-2.36%	-5.39%***	-16.44%***		Dif	-1.60%	-4.23%**	-8.09%***	-14.51%***	-24.16%***
	t-stat	(2.08)	(0.59)	(-1.57)	(-3.56)	(-10.18)		t-stat	(-0.86)	(-2.16)	(-3.87)	(-6.44)	(-7.44)
Dividend/Asset	Econ	0.53%	0.53%	0.53%	0.53%	0.54%	Total Shareholder Payout/Asset	Econ	2.14%	2.25%	2.29%	2.35%	2.37%
	Treat	0.29%	0.22%	0.19%	0.16%	0.11%		Treat	1.07%	0.92%	0.84%	0.49%	0.31%
	Control	0.32%	0.31%	0.33%	0.34%	0.35%		Control	1.19%	1.27%	1.37%	1.41%	1.37%
	Dif	-0.03%	-0.09%***	-0.14%***	-0.19%***	-0.24%***		Dif	-0.12%	-0.35%***	-0.53%***	-0.91%***	-1.05%***
	t-stat	(-1.03)	(-3.66)	(-5.34)	(-7.45)	(-8.54)		t-stat	(-1.17)	(-3.63)	(-5.23)	(-10.24)	(-11.05)
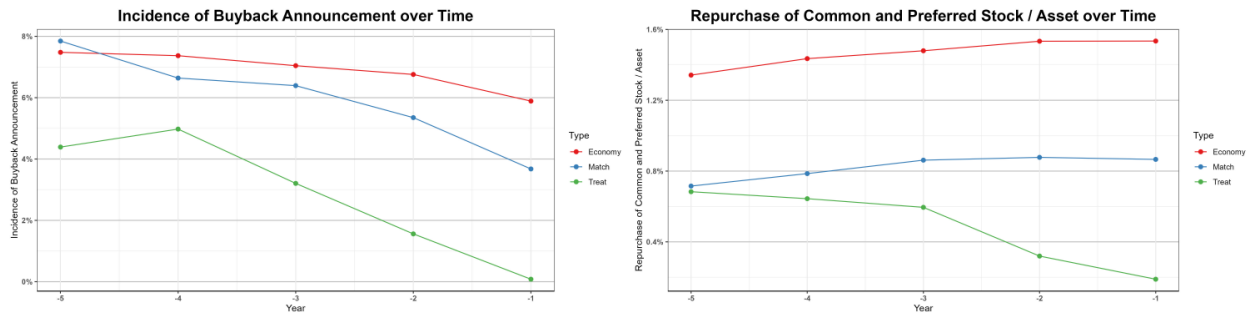
Figure 6 Buyback Announcements and Operations over Time

This figure presents an analysis of buyback announcements and operations over time across three groups: treatment firms, their matching firms, and the entire economy (including all firms in the market). The left panel depicts the frequency of buyback announcement events. By aligning the bankruptcy filing date of all treatment firms, we tally the number of buyback announcement events within each one-year time interval for five consecutive years preceding the filing date. The right panel illustrates the purchase of common and preferred stocks (scaled by asset). The economy group is depicted by the red line, the matching firm group is represented by the blue line, and the treatment firm group is indicated by the green line.

Table 15 Buyback Announcements and Operations over Time across Three Groups

This table presents the time series of the incidence of buyback announcements and the purchase of stocks across three groups: treatment firms, their matching firms, and the entire economy (including all firms in the market). To calculate the incidence of buyback announcements, we align the bankruptcy filing date of all treatment firms and tally the number of buyback announcement events within each one-year time interval for five consecutive years preceding the filing date. "Dif" row represents the mean difference between treatment firms and matching firms. The significance levels are denoted by *, **, and *** indicating 10%, 5%, and 1% significance levels, respectively.

Variable	Group	Year				
		-5	-4	-3	-2	-1
Purchase of common and preferred stocks/Asset	Econ	1.34%	1.44%	1.48%	1.53%	1.53%
	Treat	0.68%	0.64%	0.60%	0.32%	0.19%
	Control	0.72%	0.79%	0.86%	0.88%	0.87%
	Dif	-0.03%	-0.14%**	-0.27%***	-0.56%***	-0.68%***
	t-stat	(-0.48)	(-2.16)	(-3.93)	(-9.13)	(-9.99)
Incidence of Buyback	Econ	7.48%	7.37%	7.04%	6.76%	5.89%
	Treat	4.39%	4.98%	3.21%	1.56%	0.08%
	Control	7.85%	6.64%	6.39%	5.35%	3.68%
	Dif	-3.46%***	-1.66%**	-3.19%***	-3.79%***	-3.59%***
	t-stat	(-4.74)	(-2.28)	(-5.11)	(-7.30)	(-10.55)

Table 16 Dollars spent on repurchases

This table reports the percentage of dollars (scaled by total asset in the beginning of the current fiscal year) used for open-market share repurchases following the buyback announcement over a three-year period. "T" denotes the fiscal year when the buyback announcement occurred. "T + 1" represents the next fiscal year.

Z Quintile	Variable	T+1	T+2	T+3
Full Sample	value	5.33%	4.77%	4.42%
	N	7,641	7,037	6,596
Z1-Low	value	3.82%	4.85%	3.29%
	N	214	189	173
Z1-Medium	value	2.86%	2.78%	2.77%
	N	266	245	227
Z1-High	value	2.65%	2.79%	2.92%
	N	271	237	224
Z1	value	3.06%	3.37%	2.97%
	N	751	671	624
Z2	value	3.64%	3.08%	3.15%
	N	984	902	841
Z3	value	4.02%	3.56%	3.32%
	N	1,327	1,221	1,121
Z4	value	4.86%	4.42%	3.88%
	N	1,614	1,502	1,414
Z5	value	7.30%	6.40%	5.96%
	N	2,965	2,741	2,596
Z2~Z5	value	5.57%	4.92%	4.57%
	N	6,890	6,366	5,972
$Z_{<1.8}$	value	3.30%	3.45%	3.07%
	N	656	583	541
$Z_{\geq 1.8}$	value	5.52%	4.89%	4.54%
	N	6,985	6,454	6,055

Table 17 Changes in Shares after Buyback Announcement within 36 Months

This table presents the changes in shares following a buyback announcement over a 36-month period. $\Delta shares$ represents the difference in shares 36 months post-announcement compared to the day of the announcement. "Decrease Percentage" denotes the proportion of instances within specified percentage decline categories. $Z_{<1.8}$ refers to observations with a Z-Score less than 1.8.

Z Quintile	Group	N	Mean $\Delta shares$	Median $\Delta shares$	Decease Percentage			
					Decrease	By 5%+	By 10%+	By 15%+
Full Sample	Buyback Firm	6,987	17.57%	-1.77%	57.35%	37.73%	22.53%	11.62%
	Matching Firm	34,021	25.43%	3.25%	29.17%	15.23%	8.28%	4.78%
Z1-Low	Buyback Firm	178	28.21%	1.55%	44.94%	29.78%	22.47%	15.73%
	Matching Firm	927	25.38%	4.95%	26.21%	16.07%	11.76%	9.28%
Z1-Medium	Buyback Firm	239	19.87%	-0.30%	51.05%	35.98%	23.01%	13.39%
	Matching Firm	1,149	25.60%	4.20%	25.85%	13.49%	8.44%	5.40%
Z1-High	Buyback Firm	242	15.06%	-1.90%	55.79%	43.39%	22.31%	11.57%
	Matching Firm	1,189	22.78%	3.37%	29.10%	14.80%	8.16%	4.21%
Z1	Buyback Firm	659	20.35%	-0.29%	51.14%	37.03%	22.61%	13.35%
	Matching Firm	3,265	24.51%	4.02%	27.14%	14.70%	9.28%	6.06%
Z2	Buyback Firm	899	13.10%	-2.24%	59.07%	38.04%	23.47%	13.46%
	Matching Firm	4,361	20.92%	2.84%	30.11%	16.12%	8.76%	5.09%
Z3	Buyback Firm	1,181	16.80%	-1.68%	57.92%	38.53%	21.85%	11.60%
	Matching Firm	5,791	22.63%	2.72%	29.36%	15.42%	8.34%	4.92%
Z4	Buyback Firm	1,490	18.62%	-2.19%	60.20%	38.79%	22.95%	11.54%
	Matching Firm	7,178	24.61%	2.67%	31.60%	16.73%	9.07%	5.13%
Z5	Buyback Firm	2,758	18.12%	-1.70%	56.49%	36.87%	22.26%	10.66%
	Matching Firm	13,426	28.75%	3.84%	27.99%	14.18%	7.44%	4.13%
Z2~Z5	Buyback Firm	6,328	17.28%	-1.88%	58.00%	37.80%	22.52%	11.44%
	Matching Firm	30,756	25.52%	3.17%	29.39%	15.28%	8.18%	4.65%
$Z_{<1.8}$	Buyback Firm	565	19.69%	-0.58%	51.50%	36.81%	23.54%	14.87%
	Matching Firm	2,750	23.34%	3.76%	27.64%	14.87%	9.35%	6.25%

Table 18 Changes in Shares after Buyback Announcement by Quarter

This table presents the changes in shares following a buyback announcement over a 12-quarter period. It reports the mean percentage change in outstanding shares at the end of each quarter relative to the shares on the day of the announcement are reported. $Z_{<1.8}$ refers to observations with a Z-Score less than 1.8.

Z Quintile	Group	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Full Sample	Buyback	0.22%	0.81%	1.63%	2.70%	4.03%	5.71%	7.57%	9.41%	11.56%	13.57%	15.65%	17.57%
	Matching	1.92%	3.85%	5.55%	7.36%	9.27%	11.56%	13.89%	15.98%	18.32%	20.59%	23.08%	25.43%
Z1-Low	Buyback	0.19%	1.65%	2.60%	4.85%	7.75%	9.75%	12.07%	14.36%	18.11%	20.01%	27.22%	28.21%
	Matching	3.05%	5.81%	7.71%	9.44%	11.46%	13.51%	16.49%	18.38%	21.20%	23.91%	24.18%	25.38%
Z1-Medium	Buyback	0.56%	0.98%	2.63%	3.97%	4.37%	6.63%	8.18%	10.84%	13.35%	16.19%	17.49%	19.87%
	Matching	2.35%	4.42%	6.18%	8.64%	10.22%	12.91%	15.57%	17.47%	19.54%	21.35%	23.57%	25.60%
Z1-High	Buyback	1.16%	2.30%	1.76%	2.24%	3.00%	5.80%	8.23%	10.76%	11.90%	13.34%	14.60%	15.06%
	Matching	1.62%	3.33%	5.18%	7.23%	8.62%	11.14%	13.11%	15.30%	17.15%	18.83%	21.36%	22.78%
Z1	Buyback	0.67%	1.65%	2.31%	3.59%	4.85%	7.20%	9.30%	11.82%	14.16%	16.23%	19.07%	20.35%
	Matching	2.30%	4.43%	6.27%	8.36%	10.01%	12.45%	14.95%	16.95%	19.16%	21.18%	22.94%	24.51%
Z2	Buyback	0.28%	1.28%	1.96%	2.55%	3.71%	4.85%	6.47%	7.87%	9.57%	11.42%	12.35%	13.10%
	Matching	1.69%	3.51%	5.21%	6.78%	8.77%	10.85%	12.67%	14.33%	15.76%	17.35%	19.03%	20.92%
Z3	Buyback	0.11%	0.56%	0.92%	1.91%	3.34%	4.77%	6.77%	8.53%	10.81%	12.95%	14.87%	16.80%
	Matching	1.64%	3.23%	4.72%	6.10%	7.82%	10.03%	12.21%	13.96%	16.01%	18.02%	20.16%	22.63%
Z4	Buyback	-0.06%	0.32%	1.27%	2.53%	4.14%	6.00%	8.11%	9.85%	11.96%	13.62%	16.04%	18.62%
	Matching	1.81%	3.44%	4.99%	6.77%	8.63%	10.87%	13.06%	15.29%	17.59%	19.70%	22.13%	24.61%
Z5	Buyback	0.27%	0.80%	1.86%	2.96%	4.17%	5.89%	7.55%	9.48%	11.67%	13.87%	16.03%	18.12%
	Matching	2.10%	4.32%	6.15%	8.18%	10.22%	12.61%	15.20%	17.53%	20.35%	23.10%	26.22%	28.75%
Z2~Z5	Buyback	0.16%	0.71%	1.56%	2.60%	3.94%	5.55%	7.38%	9.16%	11.28%	13.29%	15.29%	17.28%
	Matching	1.88%	3.79%	5.47%	7.25%	9.18%	11.47%	13.77%	15.87%	18.23%	20.53%	23.09%	25.52%
$Z_{<1.8}$	Buyback	0.12%	0.68%	1.53%	2.84%	4.06%	6.03%	8.06%	10.81%	13.29%	15.23%	18.28%	19.69%
	Matching	2.35%	4.46%	6.18%	8.07%	9.82%	11.96%	14.42%	16.42%	18.51%	20.41%	21.79%	23.34%

Table 19 SGA / Asset Before and After the Event (Selling, General and Administrative Expense)

This table reports the SGA / Asset for buyback firms and their matching firms across different Z quintile groups and across four years before and after the event. "T+1" denotes one year forward, while "T-1" denotes one year backward. Accounting variables are calculated using Compustat quarterly data, with the quarter in which the event occurs being skipped. The T+1 variable is calculated by utilizing the four consecutive quarters following the event quarter. SGA / Asset is defined as $SGA_{t-3\sim t}/Asset_t$, where t denotes the end quarter of every consecutive four quarters. "Dif" column reports the mean difference between the average post-announcements performance (T+1~T+4) and the average prior-announcements performance (T-4~T-1). The panel B reports the difference between buyback firms and matching firms in the same group and time period. Panel C shows the results of categorization based on Z-Scores, specifically those below 1.8 and those 1.8 or above. All variables are winsorized at 1% and 99% level. *, **, *** represents 10%, 5%, and 1% significance level respectively.

Group	Treatment	T-4	T-3	T-2	T-1	T+1	T+2	T+3	T+4	Dif
Panel A: Operating Performance										
Z1	Buyback	15.43%	14.65%	14.65%	14.30%	14.90%	14.94%	14.89%	14.38%	0.30%
	Matching	18.51%	18.04%	17.78%	17.68%	17.42%	17.75%	17.85%	17.33%	-0.07%
Z2	Buyback	19.69%	18.85%	18.69%	18.78%	18.76%	18.47%	18.38%	18.08%	-0.42%***
	Matching	21.06%	20.56%	19.89%	19.84%	19.87%	19.51%	19.43%	18.98%	-0.06%
Z3	Buyback	25.15%	24.85%	24.27%	24.17%	24.22%	23.72%	23.24%	22.86%	-1.04%***
	Matching	26.05%	25.47%	24.95%	24.67%	24.53%	24.14%	23.45%	23.08%	-0.34%*
Z4	Buyback	32.34%	31.81%	31.13%	30.88%	31.12%	30.61%	30.29%	29.67%	-1.52%***
	Matching	32.02%	31.20%	30.53%	30.08%	29.92%	29.65%	29.37%	28.95%	-0.89%***
Z5	Buyback	37.85%	36.98%	35.80%	35.22%	36.13%	36.31%	35.92%	35.47%	-1.57%***
	Matching	37.07%	36.23%	34.40%	33.97%	34.40%	33.76%	33.50%	33.11%	-0.43%**
Z2~Z5	Buyback	31.46%	30.86%	30.09%	29.76%	30.24%	30.13%	29.81%	29.37%	-0.47%***
	Matching	31.43%	30.76%	29.64%	29.27%	29.43%	29.00%	28.71%	28.33%	-1.30%***
Overall	Buyback	30.04%	29.41%	28.69%	28.34%	28.83%	28.78%	28.50%	28.10%	-0.40%***
	Matching	30.28%	29.62%	28.56%	28.21%	28.32%	28.00%	27.76%	27.39%	-1.18%***
Panel B: Difference between Buyback Firm and Matching Firm										
Z1	Difference	-3.06%***	-3.35%***	-3.09%***	-3.34%***	-2.47%***	-2.77%***	-2.94%***	-2.87%***	
		(-5.42)	(-6.55)	(-6.38)	(-6.45)	(-4.67)	(-4.68)	(-4.37)	(-3.94)	
Z2	Difference	-1.38%***	-1.71%***	-1.21%***	-1.07%**	-1.12%**	-1.05%**	-1.06%**	-0.91%*	
		(-2.83)	(-3.90)	(-2.80)	(-2.49)	(-2.49)	(-2.22)	(-2.11)	(-1.77)	
Z3	Difference	-0.89%*	-0.62%	-0.68%	-0.50%	-0.31%	-0.41%	-0.21%	-0.22%	
		(-1.89)	(-1.35)	(-1.55)	(-1.14)	(-0.70)	(-0.89)	(-0.42)	(-0.43)	
Z4	Difference	0.32%	0.61%	0.60%	0.80%	1.19%**	0.97%*	0.92%*	0.72%	
		(0.61)	(1.22)	(1.21)	(1.61)	(2.32)	(1.86)	(1.65)	(1.23)	
Z5	Difference	0.78%*	0.75%*	1.40%***	1.26%***	1.73%***	2.55%***	2.42%***	2.36%***	
		(1.76)	(1.81)	(3.60)	(3.26)	(4.26)	(5.97)	(5.42)	(5.08)	
Z2~Z5	Difference	0.04%	0.10%	0.45%*	0.48%**	0.81%***	1.12%***	1.09%***	1.04%***	
		(0.14)	(0.43)	(1.95)	(2.12)	(3.41)	(4.50)	(4.16)	(3.80)	
Overall	Difference	-0.24%	-0.21%	0.13%	0.13%	0.51%**	0.78%***	0.74%***	0.71%***	
		(-1.01)	(-0.93)	(0.59)	(0.62)	(2.29)	(3.32)	(3.00)	(2.74)	
Panel C: Categorization with Z < 1.8 and Z ≥ 1.8										
$Z_{<1.8}$	Buyback	14.93%	14.12%	14.17%	13.78%	14.00%	14.20%	14.09%	13.76%	0.03%
	Matching	18.27%	17.81%	17.53%	17.31%	17.00%	17.19%	17.49%	17.15%	-0.08%
$Z_{\geq 1.8}$	Buyback	31.30%	30.70%	29.94%	29.61%	30.13%	30.00%	29.68%	29.23%	-0.43%***
	Matching	31.28%	30.62%	29.52%	29.16%	28.91%	28.60%	28.20%	-1.28%***	
$Z_{<1.8}$	Difference	-3.31%***	-3.64%***	-3.31%***	-3.49%***	-2.95%***	-2.95%***	-3.36%***	-3.29%***	
		(-5.41)	(-6.66)	(-6.50)	(-6.44)	(-5.37)	(-4.86)	(-4.83)	(-4.30)	
$Z_{\geq 1.8}$	Difference	0.02%	0.08%	0.42%*	0.45%**	0.81%***	1.09%***	1.08%***	1.03%***	
		(0.07)	(0.35)	(1.86)	(1.98)	(3.44)	(4.40)	(4.13)	(3.76)	

Table 20 Sale / Asset Before and After the Event

This table reports the Sale / Asset for buyback firms and their matching firms across different Z quintile groups and across four years before and after the event. "T+1" denotes one year forward, while "T-1" denotes one year backward. Accounting variables are calculated using Compustat quarterly data, with the quarter in which the event occurs being skipped. The T+1 variable is calculated by utilizing the four consecutive quarters following the event quarter. Sale / Asset is defined as $Sale_{t-3\sim t}/Asset_t$, where t denotes the end quarter of every consecutive four quarters. "Dif" column reports the mean difference between the average post-announcements performance (T+1~T+4) and the average prior-announcements performance (T-4~T-1). The panel B reports the difference between buyback firms and matching firms in the same group and time period. Panel C shows the results of categorization based on Z-Scores, specifically those below 1.8 and those 1.8 or above. All variables are winsorized at 1% and 99% level. *, **, *** represents 10%, 5%, and 1% significance level respectively.

Group	Treatment	T-4	T-3	T-2	T-1	T+1	T+2	T+3	T+4	Dif
Panel A: Operating Performance										
Z1	Buyback	66.06%	65.20%	64.22%	66.50%	68.87%	68.48%	69.81%	69.67%	3.83%***
	Matching	76.72%	75.86%	74.57%	75.96%	78.21%	78.03%	79.09%	78.44%	2.79%***
Z2	Buyback	96.06%	94.54%	92.94%	95.57%	94.61%	93.79%	94.19%	94.30%	-1.87%***
	Matching	99.32%	97.43%	95.03%	95.49%	95.06%	94.54%	94.93%	93.35%	-0.48%
Z3	Buyback	119.84%	118.82%	117.32%	118.01%	118.25%	116.74%	114.91%	112.78%	-4.12%***
	Matching	119.69%	117.61%	115.64%	114.82%	114.77%	113.44%	112.48%	110.85%	-2.87%***
Z4	Buyback	145.77%	144.84%	143.62%	142.23%	141.77%	137.74%	136.24%	134.71%	-7.58%***
	Matching	138.68%	136.53%	134.54%	131.64%	130.09%	128.98%	127.19%	126.24%	-6.90%***
Z5	Buyback	141.24%	140.06%	137.86%	134.08%	134.47%	134.08%	132.96%	132.08%	-8.36%***
	Matching	131.32%	128.94%	124.48%	120.77%	119.45%	118.52%	118.41%	118.21%	-7.13%***
Z2~Z5	Buyback	131.46%	130.40%	128.70%	127.26%	127.26%	125.88%	124.77%	123.74%	-5.29%***
	Matching	126.06%	123.90%	120.82%	118.46%	117.47%	116.57%	115.98%	115.20%	-6.42%***
Overall	Buyback	125.06%	123.96%	122.32%	121.20%	121.49%	120.36%	119.58%	118.73%	-4.39%***
	Matching	121.23%	119.15%	116.24%	114.21%	113.59%	112.86%	112.49%	111.79%	-5.51%***
Panel B: Difference between Buyback Firm and Matching Firm										
Z1	Difference	-10.64%***	-10.61%***	-10.29%***	-9.41%***	-9.33%***	-9.55%***	-9.24%***	-8.73%***	
		(-7.04)	(-7.25)	(-7.99)	(-6.69)	(-5.79)	(-5.71)	(-5.01)	(-4.28)	
Z2	Difference	-3.32%**	-2.94%**	-2.14%*	0.02%	-0.51%	-0.81%	-0.80%	0.89%	
		(-2.24)	(-2.09)	(-1.72)	(0.02)	(-0.35)	(-0.53)	(-0.49)	(0.51)	
Z3	Difference	0.15%	1.21%	1.68%	3.19%**	3.48%**	3.29%**	2.42%	1.92%	
		(0.10)	(0.85)	(1.26)	(2.34)	(2.42)	(2.20)	(1.51)	(1.14)	
Z4	Difference	7.09%***	8.32%***	9.08%***	10.59%***	11.68%***	8.76%***	9.04%***	8.47%***	
		(4.04)	(4.98)	(5.37)	(6.26)	(6.77)	(4.99)	(4.95)	(4.41)	
Z5	Difference	9.91%***	11.12%***	13.38%***	13.31%***	15.02%***	15.56%***	14.54%***	13.87%***	
		(7.00)	(8.15)	(10.08)	(10.45)	(11.50)	(11.39)	(10.57)	(9.74)	
Z2~Z5	Difference	5.39%***	6.49%***	7.87%***	8.79%***	9.77%***	9.30%***	8.78%***	8.53%***	
		(6.62)	(8.29)	(10.31)	(11.72)	(12.61)	(11.51)	(10.56)	(9.80)	
Overall	Difference	3.82%***	4.80%***	6.07%***	6.97%***	7.88%***	7.49%***	7.08%***	6.93%***	
		(5.09)	(6.65)	(8.64)	(10.08)	(10.96)	(9.97)	(9.13)	(8.51)	
Panel C: Categorization with Z < 1.8 and Z ≥ 1.8										
$Z_{<1.8}$	Buyback	62.88%	61.65%	60.49%	62.58%	64.90%	64.50%	65.19%	65.29%	3.19%***
	Matching	74.15%	73.31%	71.79%	73.19%	75.75%	75.81%	77.23%	75.90%	2.89%***
$Z_{\geq 1.8}$	Buyback	130.86%	129.82%	128.16%	126.76%	126.82%	125.44%	124.39%	123.34%	-5.11%***
	Matching	125.62%	123.47%	120.45%	118.11%	117.16%	116.23%	115.61%	114.89%	-6.30%***
$Z_{<1.8}$	Difference	-11.24%***	-11.61%***	-11.24%***	-10.56%***	-10.82%***	-11.30%***	-11.97%***	-10.55%***	
		(-7.10)	(-7.53)	(-8.19)	(-7.12)	(-6.43)	(-6.38)	(-6.30)	(-5.05)	
$Z_{\geq 1.8}$	Difference	5.22%***	6.34%***	7.70%***	8.64%***	9.65%***	9.19%***	8.77%***	8.44%***	
		(6.49)	(8.19)	(10.21)	(11.65)	(12.57)	(11.49)	(10.64)	(9.78)	

Table 21 ROA Before and After the Event

This table reports the ROA for buyback firms and their matching firms across different Z quintile groups and across four years before and after the event. "T+1" denotes one year forward, while "T-1" denotes one year backward. Accounting variables are calculated using Compustat quarterly data, with the quarter in which the event occurs being skipped. The T+1 variable is calculated by utilizing the four consecutive quarters following the event quarter. ROA is defined as $(ibq_{t-3\sim t})/(\frac{at_{t-3}+at_t}{2})$, where t denotes the end quarter of every consecutive four quarters, ibq denotes the quarterly income before extraordinary items, and at represents total assets. "Dif" column reports the mean difference between the average post-announcements performance (T+1~T+4) and the average prior-announcements performance (T-4~T-1).). The panel B reports the difference between buyback firms and matching firms in the same group and time period. Panel C shows the results of categorization based on Z-Scores, specifically those below 1.8 and those 1.8 or above. All variables are winsorized at 1% and 99% level. *, **, *** represents 10%, 5%, and 1% significance level respectively.

Group	Treatment	T-4	T-3	T-2	T-1	T+1	T+2	T+3	T+4	Dif
Panel A: Operating Performance										
Z1	Buyback	-0.37%	-0.73%	0.36%	2.73%	2.13%	1.17%	1.86%	2.17%	1.22%***
	Matching	-0.98%	-1.61%	-1.25%	-0.43%	-0.90%	-0.53%	-0.27%	0.31%	0.49%***
Z2	Buyback	2.88%	2.93%	2.99%	4.19%	3.16%	3.22%	3.12%	3.29%	-0.52%***
	Matching	2.10%	1.90%	1.86%	1.98%	1.24%	1.39%	1.68%	1.92%	-0.09%
Z3	Buyback	4.18%	4.19%	4.74%	5.36%	4.69%	4.32%	4.37%	4.46%	-0.72%***
	Matching	3.45%	3.41%	3.47%	3.22%	2.51%	2.48%	2.96%	3.04%	-0.15%
Z4	Buyback	5.87%	5.93%	6.83%	7.14%	6.28%	5.59%	5.21%	5.07%	-1.40%***
	Matching	4.81%	4.65%	4.86%	4.39%	3.39%	3.19%	3.39%	3.45%	-0.95%***
Z5	Buyback	8.79%	9.83%	10.35%	9.83%	7.66%	6.96%	6.74%	6.62%	-2.73%***
	Matching	4.87%	5.47%	5.62%	4.36%	2.31%	2.17%	2.50%	2.69%	-2.85%***
Z2~Z5	Buyback	6.30%	6.79%	7.37%	7.52%	6.12%	5.60%	5.42%	5.38%	-1.49%***
	Matching	4.16%	4.34%	4.48%	3.80%	2.44%	2.36%	2.67%	2.82%	-1.71%***
Overall	Buyback	5.65%	6.05%	6.67%	7.04%	5.72%	5.18%	5.08%	5.08%	-1.22%***
	Matching	3.66%	3.76%	3.91%	3.38%	2.11%	2.08%	2.40%	2.59%	-1.50%***
Panel B: Difference between Buyback Firm and Matching Firm										
Z1	Difference	0.59%	0.87%**	1.60%***	3.16%***	3.02%***	1.67%***	2.10%***	1.84%***	
		(1.37)	(2.33)	(4.90)	(9.37)	(7.73)	(4.29)	(4.86)	(4.24)	
Z2	Difference	0.78%***	1.03%***	1.12%***	2.21%***	1.92%***	1.82%***	1.44%***	1.37%***	
		(3.07)	(4.30)	(5.14)	(10.10)	(7.37)	(6.76)	(4.62)	(4.28)	
Z3	Difference	0.73%***	0.79%***	1.27%***	2.14%***	2.18%***	1.84%***	1.41%***	1.42%***	
		(3.30)	(3.86)	(7.18)	(11.50)	(10.29)	(7.63)	(5.62)	(5.32)	
Z4	Difference	1.05%***	1.28%***	1.97%***	2.75%***	2.90%***	2.40%***	1.82%***	1.63%***	
		(4.66)	(6.12)	(11.61)	(15.94)	(14.11)	(10.44)	(7.36)	(6.39)	
Z5	Difference	3.92%***	4.36%***	4.73%***	5.47%***	5.36%***	4.79%***	4.24%***	3.93%***	
		(15.57)	(19.45)	(23.23)	(27.42)	(24.21)	(20.03)	(17.43)	(15.85)	
Z2~Z5	Difference	2.13%***	2.45%***	2.89%***	3.72%***	3.68%***	3.25%***	2.74%***	2.56%***	
		(16.16)	(20.27)	(26.75)	(34.62)	(30.28)	(24.56)	(19.87)	(18.05)	
Overall	Difference	1.98%***	2.29%***	2.76%***	3.66%***	3.61%***	3.09%***	2.68%***	2.49%***	
		(15.68)	(19.94)	(26.91)	(35.78)	(31.13)	(24.70)	(20.40)	(18.49)	
Panel C: Categorization with Z < 1.8 and Z ≥ 1.8										
$Z_{<1.8}$	Buyback	-0.42%	-1.16%	-0.27%	2.39%	2.20%	1.09%	1.80%	2.05%	1.58%***
	Matching	-1.00%	-1.95%	-1.65%	-0.58%	-0.76%	-0.55%	-0.30%	0.17%	0.68%***
$Z_{\geq 1.8}$	Buyback	6.21%	6.73%	7.33%	7.49%	6.05%	5.55%	5.37%	5.35%	-1.49%***
	Matching	4.09%	4.29%	4.44%	3.75%	2.38%	2.32%	2.63%	2.80%	-1.70%***
$Z_{<1.8}$	Difference	0.57%	0.79%*	1.38%***	2.96%***	2.96%***	1.61%***	2.06%***	1.85%***	
		(1.21)	(1.94)	(3.86)	(7.85)	(6.97)	(3.74)	(4.38)	(3.92)	
$Z_{\geq 1.8}$	Difference	2.12%***	2.43%***	2.89%***	3.73%***	3.67%***	3.23%***	2.74%***	2.55%***	
		(16.14)	(20.32)	(27.02)	(35.12)	(30.49)	(24.68)	(19.99)	(18.11)	

Table 22 Operating Profit Margin Before Depreciation Before and After the Event

This table reports the Operating Profit Margin Before Depreciation for buyback firms and their matching firms across different Z quintile groups and across four years before and after the event. "T+1" denotes one year forward, while "T-1" denotes one year backward. Accounting variables are calculated using Compustat quarterly data, with the quarter in which the event occurs being skipped. The T+1 variable is calculated by utilizing the four consecutive quarters following the event quarter. The variable is defined as $(Oibdpq_{t-3\sim t})/(Sale_{t-3\sim t})$, where t denotes the end quarter of every consecutive four quarters, and $Oibdp$ denotes the quarterly operating profit before depreciation. $Oibdp$ is calculated by $coalesce(oibdpq, \ saleq - xoprq, \ revtq - xoprq)$, where $coalesce$ function means if the first term is missing then taking the second term. $oibdpq$ denotes operating income before depreciation quarterly, $saleq$ sale quarterly, $xoprq$ operating expense quarterly, $revtq$ revenue quarterly. "Dif" column reports the mean difference between the average post-announcements performance (T+1~T+4) and the average prior-announcements performance (T-4~T-1).). The panel B reports the difference between buyback firms and matching firms in the same group and time period. Panel C shows the results of categorization based on Z-Scores, specifically those below 1.8 and those 1.8 or above. All variables are winsorized at 5% and 95% level. *, **, *** represents 10%, 5%, and 1% significance level respectively. (Note: we winsorize at 5% and 95% compared to 1% and 99% in other tables, the reason for this is due to the very long tails of the distribution making for a noisy table.)

Group	Treatment	T-4	T-3	T-2	T-1	T+1	T+2	T+3	T+4	Dif
Panel A: Operating Performance										
Z1	Buyback	17.49%	17.40%	18.34%	20.04%	19.29%	18.59%	18.80%	18.78%	0.67%**
	Matching	14.79%	14.71%	14.66%	15.65%	15.60%	15.44%	15.68%	15.89%	0.71%***
Z2	Buyback	14.05%	14.11%	14.61%	15.60%	15.21%	15.30%	15.02%	14.94%	0.19%*
	Matching	13.59%	13.58%	13.69%	13.84%	13.70%	13.82%	14.03%	14.57%	0.61%***
Z3	Buyback	12.77%	12.85%	13.20%	13.74%	13.74%	13.46%	13.59%	13.74%	0.04%
	Matching	12.44%	12.58%	12.66%	12.75%	12.45%	12.47%	12.95%	13.19%	0.54%***
Z4	Buyback	12.76%	13.09%	13.47%	13.91%	13.56%	13.34%	13.23%	12.98%	-0.04%
	Matching	11.75%	11.91%	12.19%	12.19%	11.79%	11.92%	12.21%	12.30%	-0.02%
Z5	Buyback	15.57%	16.25%	16.99%	16.75%	15.26%	14.91%	14.93%	14.99%	-0.76%***
	Matching	12.19%	12.53%	13.02%	12.67%	11.73%	11.78%	12.12%	12.21%	-1.36%***
Z2~Z5	Buyback	14.14%	14.54%	15.10%	15.35%	14.57%	14.32%	14.30%	14.27%	-0.40%***
	Matching	12.34%	12.55%	12.86%	12.75%	12.17%	12.24%	12.57%	12.75%	-0.30%***
Overall	Buyback	14.46%	14.82%	15.42%	15.81%	15.03%	14.73%	14.72%	14.68%	-0.29%***
	Matching	12.57%	12.76%	13.03%	13.04%	12.50%	12.55%	12.87%	13.04%	-0.20%***
Panel B: Difference between Buyback Firm and Matching Firm										
Z1	Difference	2.68%***	2.68%***	3.65%***	4.38%***	3.68%***	3.12%***	3.10%***	2.88%***	
		(6.07)	(6.88)	(10.19)	(12.42)	(9.58)	(7.33)	(6.64)	(5.77)	
Z2	Difference	0.47%	0.54%**	0.93%***	1.77%***	1.53%***	1.50%***	1.01%***	0.39%	
		(1.61)	(1.97)	(3.42)	(6.66)	(5.18)	(4.76)	(3.24)	(1.15)	
Z3	Difference	0.33%	0.27%	0.54%**	0.99%***	1.29%***	0.99%***	0.64%**	0.55%**	
		(1.48)	(1.23)	(2.54)	(4.62)	(5.70)	(3.99)	(2.50)	(2.05)	
Z4	Difference	1.01%***	1.18%***	1.28%***	1.72%***	1.77%***	1.41%***	1.02%***	0.68%***	
		(4.69)	(5.65)	(6.27)	(8.28)	(8.28)	(6.14)	(4.22)	(2.74)	
Z5	Difference	3.39%***	3.72%***	3.97%***	4.08%***	3.53%***	3.12%***	2.81%***	2.77%***	
		(15.99)	(18.65)	(20.72)	(21.16)	(17.73)	(14.98)	(13.13)	(12.35)	
Z2~Z5	Difference	1.80%***	2.00%***	2.24%***	2.60%***	2.40%***	2.09%***	1.73%***	1.53%***	
		(14.93)	(17.27)	(19.99)	(23.17)	(20.53)	(16.80)	(13.50)	(11.37)	
Overall	Difference	1.88%***	2.07%***	2.38%***	2.78%***	2.53%***	2.18%***	1.86%***	1.65%***	
		(16.11)	(18.58)	(22.21)	(25.92)	(22.54)	(18.29)	(14.97)	(12.66)	
Panel C: Categorization with Z < 1.8 and Z ≥ 1.8										
$Z_{<1.8}$	Buyback	18.00%	17.75%	18.68%	20.57%	19.98%	19.22%	19.29%	19.42%	0.82%***
	Matching	15.07%	14.87%	14.74%	15.92%	15.96%	15.75%	15.84%	16.00%	0.72%***
$Z_{\geq 1.8}$	Buyback	14.13%	14.55%	15.11%	15.36%	14.57%	14.32%	14.32%	14.28%	-0.40%***
	Matching	12.35%	12.56%	12.87%	12.76%	12.18%	12.26%	12.60%	12.78%	-0.29%***
$Z_{<1.8}$	Difference	2.91%***	2.87%***	3.93%***	4.63%***	4.01%***	3.45%***	3.42%***	3.40%***	
		(6.21)	(6.95)	(10.28)	(12.14)	(9.75)	(7.56)	(6.74)	(6.39)	
$Z_{\geq 1.8}$	Difference	1.79%***	1.99%***	2.24%***	2.60%***	2.39%***	2.07%***	1.72%***	1.50%***	
		(14.90)	(17.27)	(20.04)	(23.35)	(20.53)	(16.77)	(13.51)	(11.22)	

Table 23 Probability of SEOs Following Buyback Announcement

This table reports the probability of observing share issuance (SEOs) after the buyback event within different horizons. $Z_{<1.8}$ refers to observations with a Z-Score less than 1.8.

Z Quintile	Group	Months				
		3	6	12	24	36
Full Sample	Buyback Firms	0.32%	0.70%	1.65%	3.68%	5.72%
	Matching Firms	4.96%	9.77%	17.05%	29.61%	37.66%
Z1-Low	Buyback Firms	0.82%	1.23%	4.51%	7.79%	10.66%
	Matching Firms	10.25%	17.62%	25.82%	41.80%	52.05%
Z1-Medium	Buyback Firms	1.36%	3.05%	4.41%	8.81%	12.20%
	Matching Firms	8.14%	14.24%	22.71%	38.31%	46.10%
Z1-High	Buyback Firms	0.33%	1.34%	2.34%	6.02%	8.70%
	Matching Firms	9.36%	15.72%	25.08%	35.12%	45.15%
Z1	Buyback Firms	0.84%	1.91%	3.70%	7.52%	10.50%
	Matching Firms	9.19%	15.75%	24.46%	38.19%	47.49%
Z2	Buyback Firms	0.72%	1.36%	2.81%	5.61%	9.23%
	Matching Firms	6.24%	12.40%	20.81%	33.85%	40.63%
Z3	Buyback Firms	0.34%	0.55%	1.38%	3.44%	5.58%
	Matching Firms	5.79%	9.92%	15.84%	30.30%	38.43%
Z4	Buyback Firms	0.23%	0.63%	1.37%	2.80%	4.40%
	Matching Firms	3.43%	7.03%	14.47%	25.16%	33.50%
Z5	Buyback Firms	0.09%	0.28%	0.99%	2.60%	4.05%
	Matching Firms	3.89%	8.75%	15.79%	28.03%	36.00%
Z2~Z5	Buyback Firms	0.27%	0.57%	1.42%	3.25%	5.18%
	Matching Firms	4.49%	9.11%	16.23%	28.65%	36.57%
$Z_{<1.8}$	Buyback Firms	1.10%	2.20%	4.26%	7.83%	10.99%
	Matching Firms	9.89%	16.48%	25.41%	38.74%	46.98%
$Z_{\geq1.8}$	Buyback Firms	0.25%	0.56%	1.40%	3.28%	5.21%
	Matching Firms	4.50%	9.13%	16.26%	28.74%	36.77%

Appendix

Table A1 BHAR across Different Z Groups and Time Periods (1990 ~ 1999)

This table reports buy-and-hold abnormal returns across different quintile groups of Z and various holding periods. The data pertains to instances where buybacks took place between 1990 and 1999. Z1 is equally divided into three subgroups based on Z-Score: low, medium, and high. If a control firm announces a buyback or is delisted during a specified calculation period, such as a 6-month return, its missing values are substituted by the market value-weighted return (VWRETD). That firm will be excluded from the portfolio in the next holding period. Z2~Z5 represents the aggregate of Z quintile group 2 to 5. Mean Dif $(Z1 - Z2\sim Z5)$ denotes the mean difference of BHAR between Z1 and the aggregate of Z2 to Z5. Panel A delineates the categories based on Z-Quintile distinctions. Panel B shows the categorization based on Z-Scores, specifically those below 1.8 and those 1.8 or above. Mean Dif $(Z_{<1.8} - Z_{\geq 1.8})$ denotes the mean difference of BHAR between groups with Z-Score below 1.8 and those 1.8 or above. Before portfolio formation, returns are winsorized at the 1% and 99% level. *, **, *** represents 10%, 5%, and 1% significance level respectively.

	3-month	6-month	1-year	2-year	3-year	4-year
			Buy-and-Hold Abnormal Return			
Panel A: Categorization using Z-Quintile						
Full Sample	0.90%**	1.20%**	0.57%	0.05%	0.50%	9.65%***
	(2.31)	(2.05)	(0.55)	(0.02)	(0.21)	(3.12)
	3,368	3,362	3,319	3,211	2,988	2,776
Z1-Low	6.02%**	7.31%*	14.63%**	23.16%**	28.81%	37.49%
	(2.15)	(1.88)	(2.18)	(2.18)	(1.60)	(1.48)
	90	89	89	83	74	63
Z1-Medium	-1.09%	-0.23%	-4.58%	-4.39%	-5.79%	-2.09%
	(-0.70)	(-0.09)	(-1.15)	(-0.62)	(-0.58)	(-0.14)
	118	118	116	113	106	98
Z1-High	-1.59%	-4.01%	-6.19%	-6.89%	5.62%	33.58%
	(-0.71)	(-1.42)	(-1.33)	(-1.05)	(0.52)	(1.18)
	92	91	91	88	79	76
Z1	0.83%	0.80%	0.65%	2.82%	7.13%	19.25%
	(0.66)	(0.46)	(0.22)	(0.60)	(0.97)	(1.51)
	300	298	296	284	259	237
Z2	1.02%	1.21%	1.06%	1.64%	-1.37%	2.53%
	(1.07)	(0.81)	(0.42)	(0.32)	(-0.25)	(0.38)
	395	393	386	366	337	318
Z3	1.64%**	3.11%***	1.77%	3.14%	-0.64%	6.36%
	(2.12)	(2.59)	(0.85)	(0.87)	(-0.14)	(1.19)
	593	593	581	563	517	465
Z4	0.30%	-0.06%	2.77%	4.52%	9.62%**	16.27%***
	(0.40)	(-0.05)	(1.26)	(1.27)	(2.04)	(2.73)
	737	736	731	710	675	637
Z5	0.86%	1.15%	-1.49%	-4.94%	-5.08%	7.00%
	(1.21)	(1.07)	(-0.80)	(-1.15)	(-1.14)	(1.25)
	1,343	1,342	1,325	1,288	1,200	1,119
Z2~Z5	0.90%**	1.24%**	0.55%	-0.20%	-0.13%	8.68%***
	(2.20)	(2.00)	(0.50)	(-0.09)	(-0.05)	(2.75)
	3,068	3,064	3,023	2,927	2,729	2,539
Mean Dif **$(Z1 - Z2\sim Z5)$**	-0.10%	-0.46%	0.03%	2.58%	7.11%	10.71%
	(-0.07)	(-0.25)	(0.01)	(0.49)	(0.91)	(0.81)
Panel B: Categorization with Z < 1.8 and Z ≥ 1.8						
$Z_{<1.8}$	2.16%	2.78%	2.63%	5.74%	7.47%	9.12%
	(1.48)	(1.30)	(0.73)	(0.95)	(0.80)	(0.71)
	219	218	216	206	192	174
Mean Dif **$(Z_{<1.8} - Z_{\geq 1.8})$**	1.34%	1.65%	2.30%	5.88%	7.51%	-0.41%
	(0.88)	(0.74)	(0.61)	(0.92)	(0.78)	(-0.03)

Table A2 BHAR across Different Z Groups and Time Periods (2000 ~ 2009)

This table reports buy-and-hold abnormal returns across different quintile groups of Z and various holding periods. The data pertains to instances where buybacks took place between 2000 and 2009. Z1 is equally divided into three subgroups based on Z-Score: low, medium, and high. If a control firm announces a buyback or is delisted during a specified calculation period, such as a 6-month return, its missing values are substituted by the market value-weighted return (VWRETD). That firm will be excluded from the portfolio in the next holding period. Z2~Z5 represents the aggregate of Z quintile group 2 to 5. Mean Dif $(Z1 - Z2\sim Z5)$ denotes the mean difference of BHAR between Z1 and the aggregate of Z2 to Z5. Panel A delineates the categories based on Z-Quintile distinctions. Panel B shows the categorization based on Z-Scores, specifically those below 1.8 and those 1.8 or above. Mean Dif $(Z_{<1.8} - Z_{\geq 1.8})$ denotes the mean difference of BHAR between groups with Z-Score below 1.8 and those 1.8 or above. Before portfolio formation, returns are winsorized at the 1% and 99% level. *, **, *** represents 10%, 5%, and 1% significance level respectively.

	Buy-and-Hold Abnormal Return					
	3-month	6-month	1-year	2-year	3-year	4-year
Panel A: Categorization using Z-Quintile						
Full Sample	1.25%***	1.59%***	3.78%***	5.14%***	6.74%***	10.17%***
	(3.08)	(2.73)	(4.16)	(3.42)	(3.39)	(3.68)
	2,443	2,440	2,427	2,358	2,234	2,131
Z1-Low	1.48%	-0.33%	6.07%	7.18%	23.22%*	35.80%*
	(0.58)	(-0.10)	(1.17)	(0.84)	(1.80)	(1.81)
	96	96	95	92	80	73
Z1-Medium	5.31%*	1.76%	6.25%	10.82%	26.91%**	51.96%*
	(1.94)	(0.50)	(1.15)	(1.26)	(2.06)	(1.73)
	66	66	65	64	60	57
Z1-High	2.83%*	5.05%**	8.89%**	13.77%**	16.74%	24.60%
	(1.72)	(2.22)	(2.40)	(2.09)	(1.63)	(1.63)
	80	80	80	79	70	66
Z1	3.00%**	2.12%	7.14%**	10.75%**	22.36%***	36.84%***
	(2.20)	(1.18)	(2.59)	(2.34)	(3.21)	(2.99)
	242	242	240	235	210	196
Z2	-0.04%	-0.53%	0.36%	-0.69%	-3.31%	-0.37%
	(-0.03)	(-0.35)	(0.15)	(-0.19)	(-0.66)	(-0.06)
	299	298	296	288	275	260
Z3	1.52%	1.21%	4.92%*	3.25%	3.91%	4.50%
	(1.46)	(0.86)	(1.80)	(0.85)	(0.80)	(0.73)
	378	378	374	364	345	332
Z4	1.16%	1.63%	3.65%*	4.56%	3.63%	12.78%**
	(1.41)	(1.34)	(1.91)	(1.42)	(0.98)	(2.07)
	460	460	458	440	415	396
Z5	1.15%*	2.26%**	3.61%***	6.28%**	8.47%***	8.30%**
	(1.81)	(2.37)	(2.68)	(2.57)	(2.60)	(2.02)
	1,064	1,062	1,059	1,031	989	947
Z2~Z5	1.06%**	1.53%**	3.40%***	4.46%***	5.02%**	7.28%***
	(2.49)	(2.49)	(3.53)	(2.81)	(2.43)	(2.64)
	2,201	2,198	2,187	2,123	2,024	1,935
Mean Dif **$(Z1 - Z2\sim Z5)$**	1.93%	0.56%	3.88%	6.89%	18.37%**	31.54%**
	(1.34)	(0.30)	(1.35)	(1.44)	(2.56)	(2.50)
Panel B: Categorization with Z < 1.8 and Z ≥ 1.8						
$Z_{<1.8}$	3.09%*	1.42%	5.90%*	7.91%	20.74%**	36.55%**
	(1.87)	(0.65)	(1.75)	(1.39)	(2.51)	(2.47)
	193	193	191	186	170	159
Mean Dif **$(Z_{<1.8} - Z_{\geq 1.8})$**	1.99%	-0.05%	2.67%	4.17%	16.89%**	31.19%**
	(1.17)	(-0.02)	(0.79)	(0.72)	(2.02)	(2.09)

Table A3 BHAR across Different Z Groups and Time Periods (2010 ~ 2021)

This table reports buy-and-hold abnormal returns across different quintile groups of Z and various holding periods. The data pertains to instances where buybacks took place between 2010 and 2021. Z1 is equally divided into three subgroups based on Z-Score: low, medium, and high. If a control firm announces a buyback or is delisted during a specified calculation period, such as a 6-month return, its missing values are substituted by the market value-weighted return (VWRETD). That firm will be excluded from the portfolio in the next holding period. Z2~Z5 represents the aggregate of Z quintile group 2 to 5. Mean Dif $(Z1 - Z2 \sim Z5)$ denotes the mean difference of BHAR between Z1 and the aggregate of Z2 to Z5. Panel A delineates the categories based on Z-Quintile distinctions. Panel B shows the categorization based on Z-Scores, specifically those below 1.8 and those 1.8 or above. Mean Dif $(Z_{<1.8} - Z_{\geq1.8})$ denotes the mean difference of BHAR between groups with Z-Score below 1.8 and those 1.8 or above. Before portfolio formation, returns are winsorized at the 1% and 99% level. *, **, *** represents 10%, 5%, and 1% significance level respectively.

| | Buy-and-Hold Abnormal Return | | | | | |
	3-month	6-month	1-year	2-year	3-year	4-year
Panel A: Categorization using Z-Quintile						
Full Sample	1.58%***	2.50%***	4.56%***	6.01%***	8.89%***	12.16%***
	(5.19)	(5.52)	(6.46)	(4.92)	(5.20)	(5.18)
	2,566	2,549	2,506	2,281	2,060	1,807
Z1-Low	3.16%	3.06%	2.04%	-8.99%	-9.65%	-5.65%
	(1.42)	(0.77)	(0.33)	(-1.12)	(-0.64)	(-0.36)
	58	58	55	51	42	34
Z1-Medium	2.05%	0.99%	2.61%	2.91%	6.62%	16.00%
	(1.13)	(0.39)	(0.64)	(0.45)	(0.65)	(1.27)
	110	110	108	99	83	73
Z1-High	1.58%	1.60%	4.54%	5.84%	26.03%**	36.43%***
	(1.25)	(0.83)	(1.50)	(1.02)	(2.56)	(2.70)
	127	124	122	111	96	80
Z1	2.11%**	1.68%	3.33%	1.54%	12.33%*	21.48%***
	(2.17)	(1.14)	(1.43)	(0.40)	(1.89)	(2.62)
	295	292	285	261	221	187
Z2	1.36%*	2.65%**	4.56%**	3.47%	5.76%	15.48%***
	(1.96)	(2.26)	(2.57)	(1.17)	(1.50)	(2.86)
	411	407	397	366	326	277
Z3	1.70%**	2.49%**	6.27%***	7.78%***	13.46%***	11.61%**
	(2.49)	(2.51)	(4.09)	(2.99)	(3.30)	(2.46)
	480	477	467	423	382	337
Z4	1.91%***	3.45%***	5.15%***	10.21%***	10.36%***	13.65%***
	(2.75)	(3.62)	(3.22)	(3.43)	(3.07)	(2.75)
	552	549	541	485	445	396
Z5	1.19%**	2.12%***	3.57%***	4.91%**	5.45%*	7.20%*
	(2.28)	(2.70)	(3.02)	(2.42)	(1.81)	(1.65)
	828	823	814	745	686	608
Z2~Z5	1.52%***	2.62%***	4.71%***	6.57%***	8.40%***	11.15%***
	(4.77)	(5.53)	(6.38)	(5.10)	(4.76)	(4.56)
	2,271	2,257	2,221	2,020	1,839	1,620
Mean Dif	0.48%	-1.03%	-1.39%	-4.61%	5.28%	10.14%
$(Z1 - Z2 \sim Z5)$	(0.48)	(-0.68)	(-0.58)	(-1.17)	(0.83)	(1.22)
Panel B: Categorization with Z < 1.8 and Z ≥ 1.8						
$Z_{<1.8}$	2.38%**	2.13%	3.01%	0.37%	9.42%	17.08%**
	(2.55)	(1.43)	(1.29)	(0.10)	(1.51)	(2.15)
	315	311	299	266	225	186
Mean Dif	0.79%	-0.44%	-1.48%	-5.64%	2.35%	5.67%
$(Z_{<1.8} - Z_{\geq1.8})$	(0.82)	(-0.29)	(-0.62)	(-1.41)	(0.38)	(0.70)