Bonus-driven Repurchases*

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This version: March 29, 2010

Abstract

We examine explicit financial incentives that CEOs have to manipulate their bonus payments through repurchases. Utilizing a large hand-collected database of CEO bonus structures, we test whether CEOs use repurchases to manage earnings per share for the purpose of their own monetary benefit. We find that when a CEO's bonus is directly tied to earnings per share (EPS), his company is more likely to conduct a buyback and the magnitude of the buyback tends to be larger. Share repurchasing has a positive impact on the probability of receiving a bonus and the magnitude of that bonus, only when the bonus pay is determined by EPS. Furthermore, when the company's EPS is close to the EPS threshold for a bonus award, the company is more likely to conduct a share buyback. Unlike many other repurchases, bonus-driven repurchases are not motivated by perceived undervaluation; bonus-driven repurchasing firms do not exhibit positive long-run abnormal returns while, consistent with prior research, we find that other repurchasing firms do. Bonus-design can create a purely personal incentive to initiate a repurchase.

* We thank seminar participants at George Mason University, Hong Kong University of Science and Technology, Nanyang Technological University of Singapore, National University of Singapore, and Singapore Management University for many helpful comments.

1. Introduction

Annual stock repurchases have increased tremendously since 1982, such that in 2007, the total repurchases by industrial firms exceeded $420 billion. Skinner (2008) concludes that "repurchases are now the dominant form of payout." Explanations for the rise in repurchases have included flexibility (Guay and Harford, 2000; Jagannathan, Stephens and Weisbach, 2000), tax efficiency, lack of dividend-protection on executive options (Fenn and Liang, 2001), and funding of employee stock option exercises (Kahle, 2002). Recent research has also suggested that managers sometimes make sub-optimal decisions to repurchase shares to improve earnings per share (Bens, Nagar, Skinner, and Wong, 2003; Hribar, Jenkins, and Johnson, 2006).[1] However, little has been done to examine why managers make such decisions. In this study we examine explicit financial incentives that CEOs have to manipulate the earnings per share through repurchases.

One reason given by managers for preferring to fund option exercises out of repurchases rather than newly–issued shares is a desire to avoid earnings per share (EPS) dilution. Thus, managers are acutely aware of the effect of repurchases on the denominator in EPS. According to the survey by Brav, Graham, Harvey, and Michaely (2005), improving EPS numbers is the most frequently mentioned reason for stock repurchases by corporate managers. Many bonus plans are tied to EPS, creating further incentive to decrease the shares outstanding through repurchases. We hypothesize that firms are more likely to undertake share buybacks when their CEO's bonus is tied to EPS. We also expect that CEOs benefit from share repurchases when their bonus pay is determined by EPS. Further, we hypothesize that the probability of firms conducting share repurchases increases when their EPS is close to the threshold EPS that triggers a bonus award. Finally, because the motivation for these

[1] Bens, Nagar, Skinner, and Wong (2003) find that firms shift resources away from real investments towards repurchasing their own stocks, and Hribar, Jenkins, and Johnson (2006) suggest that managers use repurchases as a tool to meet or exceed analysts' EPS forecasts.

repurchases is different, we expect the post-repurchase performance to be different as well. Specifically, we hypothesize that bonus-driven repurchasing firms will not exhibit positive long-run abnormal returns, in contrast to the findings for repurchases in general (see Ikenberry, Lakonishok and Vermaelen, 1995).

Utilizing a large hand-collected database of CEO bonus structure, we test whether CEOs use share buybacks to manage EPS for the purpose of their own monetary benefits. In our sample, we find that 49% of the CEOs have their bonus tied to EPS while 30% of the CEOs do not have a bonus structure depending on EPS (the rest of the observations either do not have a bonus plan or they do not specify the determining factors of CEO bonus). This variation allows us to examine the impact of CEOs' personal motivations on share repurchases. We are able to differentiate a spurious relation between bonuses and repurchases from a more meaningful relation between bonuses and EPS-driven repurchases.

We find that when a CEO's bonus is directly tied to EPS, his company is more likely to conduct a repurchase and the magnitude of the repurchase tends to be larger. Controlling for other explanatory factors, tying the CEO's bonus to EPS would increase the scaled share buyback by 0.5% of the market value of equity, which is about a third of the sample mean. The tie of CEO bonus to EPS also significantly increases the probability of a firm having positive net repurchases. These results are robust in the two-step self-selection model and propensity score matching procedure. Furthermore, when a CEO's bonus is tied to EPS, repurchasing shares has a positive impact on the probability of the CEO receiving a bonus and the magnitude of that bonus. On average, conducting a share buyback increases the level of bonus by approximately 36% when the bonus is tied to EPS. Both multivariate regressions and propensity score matching confirm that repurchasing shares affects CEO bonuses positively and significantly when EPS is a determining factor of the bonus.

We compute what the EPS would be if a firm does not repurchase, labeled *As-if EPS*. If *As-if EPS* is less than but within 15% of the threshold earnings per share, we say it is close to the threshold. We

also use 10% and 20% as the cutoff, and the results are qualitatively the same. We find that, when the company's *As-if EPS* is close to the threshold earnings per share for a bonus award, the company is especially likely to conduct a repurchase. When *As-if EPS* is close to the threshold EPS, 75% of the observations conduct share buyback, significantly higher than the 61% when *As-if EPS* is not close to the threshold EPS. Multivariate analysis confirms that firms are more likely to repurchase when their *As-if EPS* is close to the threshold EPS.

The literature has identified many reasons for a firm to conduct a share buyback, including undervaluation. We examine the repurchasing firms' three-year post-buyback stock performance. We find that the whole sample of repurchasing firms demonstrates positive (significant at 10% level) abnormal returns, consistent with Ikenberry, Lakonishok and Vermaelen (1995). However, consistent with the repurchase motivation being bonus-manipulation, the subset of firms whose CEO bonus is tied to EPS do not outperform their matching non-repurchasing firms.

We draw on the literature on accounting targets in CEO compensation, beginning with Healy (1985), who hypothesizes that bonus schemes could induce CEOs to manipulate earnings. Studying discretionary earnings accruals and bonus structure of 94 firms, he found evidence supporting his hypothesis: accrual policies of managers are related to income-reporting incentives of their bonus contracts. We investigate how CEO compensation plans influence repurchasing activity for more than 1,000 firms over as long as 14 years. Our focus is on CEOs' motivation to repurchase and their ability to manipulate EPS through such repurchases. Marquardt, Tan, and Young (2009) study the managers' decisions to undertake accelerated share repurchases (ASRs) versus open market repurchases (OMRs). Using 70 ASR and 201 OMR announcements over 2004-2006, they find that firms are more likely to choose ASRs over OMRs when CEOs' bonus compensation is tied to EPS, due to differences in accounting treatments between ASRs and OMRs. However, they do not examine whether CEOs benefit from the repurchasing. Different from Marquardt, Tan, and Young (2009), we predict a positive relation between the tie of bonus to EPS and the likelihood of repurchases in general; we

focus on the link between CEO bonus structure and the annual net repurchasing in the broad sample of industrial firms (repurchasing and non-repurchasing) over 1993-2007 (fiscal year); and we explicitly establish that CEOs benefit from repurchasing when their bonus pay is tied to EPS, creating a purely personal incentive to initiate a repurchase. Thus, we provide a critical piece that has been missing from prior studies on managerial opportunistic behavior around share repurchases.

Our paper is also related to studies examining managers' incentives to meet or exceed certain accounting benchmarks by opportunistically engaging in various operating, investing, and financing activities during the fiscal period (e.g., Bange and De Bondt, 1998; Bens et al., 2003; Roychowdhury, 2006; Hribar et al. 2006). Our study complements, and is consistent with, the findings in Hribar, et al. (2006), who establish that repurchasing can influence EPS and find that the desire to meet or beat analysts' EPS forecasts influences the stock repurchase decisions of some firms. However, these studies do not examine the specific benefits brought to managers by meeting or exceeding benchmarks. Further, the EPS threshold for bonus awards has several advantages over analysts' EPS expectation, which has been the most commonly used threshold in manipulation studies.[2] Finally, we show that these EPS-motivated repurchases are different from other repurchases in terms of long-run returns.

The remainder of the paper is organized as follows. The next section discusses and presents the hypotheses. Section 3 describes our data collection and sample selection procedures. Section 4 reports

[2] First, analysts keep revising their earnings forecasts up to the day prior to the earnings announcement which happens after the end of the fiscal year. By contrast, the target EPS for CEO bonus award is set and written into the executive compensation contract at the start of a fiscal year. CEOs may more likely act opportunistically to meet or exceed an *ex ante* benchmark. Second, managers can exert their influence on analysts and guide analysts' earnings forecasts down to the level that they can meet or exceed (Richardson, Teoh, and Wysocki, 2004). Because the costs of guiding analysts are relatively low, managers may prefer "walk-down" analysts' forecasts to engaging costly real-activity manipulations for meeting or exceeding analysts' forecasts. In contrast, managers have little influence on the EPS criterion for CEO bonus award once it is set and written into the executive compensation contract at the beginning of the fiscal year. Third, there are variations in analysts' earnings expectations across analysts and over time. The benchmark EPS for CEO bonus award, on the other hand, is an objective measure for CEO's performance and a clear target for CEO to reach.

the empirical tests and results. Section 5 reports a number of robustness tests. The study concludes in Section 6.

2. Hypothesis development

Share repurchases reduce the number of shares outstanding. As long as the opportunity cost to earnings of the cash employed in the buyback is low, the buyback mechanically increases current EPS when the earnings are positive. When a CEO's bonus is tied to EPS, he/she would be motivated to repurchase shares to increase his/her personal wealth. As a result, we should observe that firms are more likely to repurchase when EPS is one factor in their CEO's bonus contract. A share buyback would have a positive impact on the CEO bonus when the bonus is tied to EPS. The impact can be measured in terms of the probability of a bonus award and the magnitude of bonus. We thus have our first hypothesis:

Hypothesis 1: *When a firm's CEO's bonus is tied to EPS, it is more likely to repurchase shares; when a CEO's bonus is tied to EPS, share repurchases will increase the bonus, in terms of both the probability of being awarded a bonus and the magnitude of the bonus.*

In the sample of Healy (1985), the typical bonus structure is such that if the level of earnings is less than a lower bound, managers do not receive a bonus. Healy (1985) suggests that managers are more likely to choose income-increasing discretionary accruals when the earnings before discretionary accruals are close to the threshold. If the earnings before discretionary accruals are too low, the reported income, even with the maximum income-increasing discretionary accruals, will not exceed the lower bound and no bonus will be awarded.

In our study, we focus on the impact of share buybacks on the denominator of earnings per share. If the EPS without the buyback is less than the threshold EPS by a large amount, CEOs would also have less incentive to repurchase since the buyback is unlikely to help put the reported EPS above the threshold. However, if the EPS is less than but close to, the threshold, CEOs are motivated to

repurchase since a buyback now is likely to move the reported EPS beyond the threshold. Therefore we have the following hypothesis:

Hypothesis 2: *Firms are more likely to conduct share repurchases when their earnings per share are less than but close to the level that triggers the bonus.*

The extant literature has provided several hypotheses on why a firm conducts a share buyback, including distributing excess cash, achieving target leverage ratio, avoiding a takeover, avoiding stock option dilution, and signaling undervaluation. We discuss those hypotheses in detail in the next section and control for them in the empirical tests. If the primary motivation of some repurchases is to positively affect EPS for CEOs' personal gain, then typically observed effects, such as the positive long-run abnormal returns documented by Ikenberry, Lakonishok, and Vermaelen (1995), will be absent. Thus, we have the following hypothesis:

Hypothesis 3: *When CEO bonus is determined by EPS, shares of the repurchasing firms do not fare better in the post-buyback period than shares of the matching non-repurchasing firms.*

One might wonder why the board writes an incentive contract that can be manipulated. There are several, non-mutually exclusive reasons that explain the existence of such contracts. First, the board may be captured, in which case we would expect measures of governance to vary with the use of EPS-linked bonuses. We test this prediction and find some support for it. Second, the board may be perfectly rational in the sense that it completely understands the incentives of the contract and adjusts some other part of the CEO's compensation downward to offset the expected manipulation-driven portion of the bonus. Third, the board may accept the potential for manipulation as a necessary friction in writing a compensation contract that provides the appropriate incentives for value-maximizing investment. That is, the board cannot write a perfect contract and accepts this tradeoff in order to get the investment incentives right. Finally, the board may not realize the potential for manipulation (we prefer not to rely on this explanation, but it does exist).

In the Appendix, we summarize the results from searching the proxies of our sample firms for any discussion of the potential impact of repurchasing on an EPS-linked bonus. Fewer than 0.5% of the proxies mention this possibility and even fewer state that the compensation committee would consider adjusting EPS for the impact of a repurchase in determining bonus eligibility. The committee typically states that the majority of EPS growth comes from operations, not from repurchases. Further, they state that share repurchases generally benefit shareholders and they could be done for various reasons (for example, to distribute excess cash to shareholders or to offset the dilution from employee option exercising, etc.) and the CEO should not be "punished" for doing so. It is impossible or at least very difficult for the board to write a contract that distinguishes among a number of reasons underlying a repurchase and decides whether to adjust EPS accordingly in a way that would be ex ante agreeable to the CEO.

3. Data sources, sample selection and descriptive statistics

3.1 Sample selection

Two of the data sources are COMPUSTAT's Industrial Annual database and Execucomp dataset. Execucomp provides detailed information on the compensation of the top five executives of S&P 1,500 firms since 1992. We obtain these firms' financial information from COMPUSTAT.[3] We exclude financial and utility firms, firms with negative book value of equity, and firms with share price less than $1. There are 17,555 firm-year observations during 1992-2007 in the COMPUSTAT-and-Execucomp-merged sample.

To obtain specific details on CEOs' bonus structures, we extract the annual proxy statements (DEF 14A) filed by the firms from SEC website. The electronic filings on the SEC website start from

[3] COMPUSTAT adopts a new version of data format, starting from fiscal year 2007. One of the main changes in the new version is that the data are labeled by abbreviated letter names, not by item numbers. For example, "total assets" is named "AT" in the new version, not "data 6" as in the old version. To be comparable with the previous work (e.g., Skinner, 2008), we still describe the data by their item numbers in our analysis, although our sample covers fiscal year 2007.

1994, providing proxy statements filed between 1994 and 2008 (fiscal year 1993-2007). After matching the proxy statements with our COMPUSTAT-and-Execucomp-merged sample, we have 12,476 firm-year observations by 1,423 companies in the final sample, from 1993 to 2007 (fiscal year).

3.2 Data collection on CEOs' bonus structure

We read all 12,476 proxy statements, and collect information on the bonus structure of CEOs. The common practice is that the bonus is a performance-based incentive plan that is paid in cash shortly after the end of the fiscal year. The compensation committee decides the criteria of the bonus award at the beginning of the fiscal year. Some companies provide a very detailed description of the evaluating factors that determine the CEO bonus in their SEC filings, while some are very vague about the process. Bonus calculations vary among firms, but generally no bonuses are payable if the threshold goals are not attained. That is, if the CEO's performance is below a minimum level of the measures, he will not receive a cash bonus; if his performance meets the minimum criteria, he is eligible to receive a bonus.

The following is one example obtained from the proxy statement of Cintas Corp, an S&P 500 company, filed on August 25, 1995:

"The performance incentive compensation, which is paid out in the form of an annual cash bonus, was established by the Committee to provide a direct financial incentive to achieve corporate and operating goals. The basis for determining performance incentive compensation is strictly quantitative in nature. At the beginning of each fiscal year, the Committee establishes a target bonus for each executive. For fiscal 1995, the target bonus for Mr. Kohlhepp (the CEO) was expressed as a percentage of his base pay. The program was based on target levels of increases in earnings per share and provided for no bonus if earnings per share did not exceed a minimum threshold of a 10% increase over the prior year's earnings per share which was $1.12. The bonus potential ranged from 7% of base salary if earnings per share increased by twelve cents over the prior year up to a

maximum of 80% of base salary if earnings per share increased by twenty-eight cents over the prior year."

We collect the following data items on the CEO bonus:

- Whether EPS is one of the factors in determining the bonus
- If EPS is a factor in determining the bonus, the threshold EPS for the CEO to receive a bonus
- The target ratio of the bonus to the base salary of the CEO, which is the ex-ante expected level of bonus divided by the base salary.

A CEO's bonus is often tied to EPS (e.g., Matsunaga and Park, 2001). As shown in Panel A of Table 1, about 2.3% of the observations do not have a bonus component in the CEO compensation. In around 19% of our sample, the firms do not specify the evaluating factors for bonus award, thus we are unable to determine whether EPS is a factor in bonus decision. About 49% of the sample has a bonus component that is tied directly to EPS, while in about 30% of the cases the bonus is not determined by EPS.

Insert Table 1

In Panel B of Table 1, we report the probability of within-firm one-year transition among the above four types. The within-firm bonus structure is stable over time. If a firm does not determine CEO bonus based on EPS in year t, its probability of not linking CEO bonus to EPS in year t+1 is, on average, 86.85%. If the CEO bonus is based on EPS in year t, the probability of the CEO bonus depending on EPS in year t+1 is, on average, 92.80%.

Figure 1 plots the distribution of the four types over time. The percentage of firms that do not have a bonus component in CEO compensation remains around 2%. The fraction of firms in the group of "cannot determine" decreases over time, especially during the more recent years. The reason is that firms provide more detailed information on bonus determinants in their proxy statement in more recent

years. The group of firms that link CEO bonus to EPS has increased since 2002, outpacing the increase of the firms that do not use EPS as a determining factor of CEO bonus.

Insert Figure 1

Among the firms that base CEO bonus on EPS, the majority of them do not disclose the threshold earnings per share, often treating it as confidential business information that they do not want to be available to their competitors. For example, Cypress Semiconductor Corp, in their proxy statement of fiscal year 2007, says "*The details of the specific earnings per share target have not been included in this proxy statement in order to maintain the confidentiality of our earnings per share expectations, which we believe are confidential commercial or business information, the disclosure of which would adversely affect the Company.*" Another example, Sun Microsystems, Inc., in their proxy of fiscal year 2000, states *"During fiscal year 2000, bonuses awarded were calculated based on the achievement by Sun of certain earnings per share ("EPS") and revenue goals set by the Committee at the beginning of fiscal year 2000. The EPS and revenue targets are all based on confidential information and are competitively sensitive to Sun as they are derived from Sun's internal projections and business plan."* For about 7% of the observations that tie their CEO bonus directly to earnings per share, we have found the threshold EPS for CEOs to receive a bonus: 185 firms disclose the threshold EPS in 402 firm-year observations. The majority of those observations use basic EPS, while 27% of them involve diluted EPS. To ease the concern of a potential sample selection bias, we compare the firms that disclose the threshold EPS with the firms that do not. We find that there are no statistically significant differences between the two groups of firms in terms of size, cash flow, profitability, dividend payout ratio, market-to-book, leverage, and industry-adjusted leverage. Therefore there is no reason for us to believe that these two groups are fundamentally different from each other.

About 20% of the proxy statements explicitly specify the target bonus ratio for their CEOs, which is the expected level of bonus divided by salary. Figure 2 plots the average target bonus-to-salary ratio for each fiscal year from 1993 to 2007. The target bonus-to-salary ratio exhibits great growth from the

1990s to 2000s. In 2007, the target bonus is, on average, about 105% of the salary. This demonstrates the economic significance of bonus in CEO compensation: it represents a substantial amount of income for CEOs. Further, even for ostensibly wealthy CEOs, the bonus provides much of the liquid wealth in any given year, as most of these CEOs' wealth is in unexercisable options or restricted stock.

Insert Figure 2

3.3 Measuring share buyback and firm characteristics

Following Fama and French (2001), and Skinner (2008), we measure share buyback as net repurchases. We calculate the net repurchases as the increase in common treasury stock (COMPUSTAT #226). Treasury stock captures the cumulative effects of stock repurchases and reissues. If treasury stock is zero in the current and prior year, we measure net repurchases as the difference between stock purchase (#115) and stock issuance (#108). If either the change in treasury stock or the difference between #115 and #108 is negative, net repurchases are set to zero. As discussed by Skinner (2008), it is preferable to use the change in treasury stock, if available, rather than net purchases (#115–#108) because the change in treasury stock nets out any associated issuances, including non cash issuances. We use both dollar amount of repurchases and scaled repurchases (dollar amount of repurchases divided by prior year end market value of equity). In Figure 3, we plot the dollar amount of net repurchases by all industrial firms listed on COMPUSTAT from 1960 to 2007. It is clear that the dollar amount of repurchasing has increased dramatically during the past two decades.

Insert Figure 3

We consider the various determinants of repurchases, based on the extant theories in the literature. According to the distribution of excess cash hypothesis (Jensen, 1986; Easterbrook, 1984; Guay and Harford, 2000; Jagannathan, Stephens, and Weisbach, 2000; and Grullon and Michaely, 2002), if a firm has cash in excess of its investment opportunities, it may use repurchases as a substitute for dividends to pay out this excess cash to shareholders. We thus include cash holdings, profitability, and

dividend payout ratio in the analysis of share buyback. We compute cash holdings as the ratio of cash and equivalents to the total assets in the prior fiscal year. Profitability is the ratio of net income to the total assets in the prior fiscal year. Dividend payout ratio is the dividend paid to common stock divided by net income in the prior fiscal year.[4]

According to the target leverage ratio hypothesis (Bagwell and Shoven, 1988; Opler and Titman, 1996; and Lie, 2002), firms may use stock repurchases to increase their leverage and thus achieve a target leverage ratio. Leverage is calculated as the sum of long-term debt and debt in current liabilities scaled by total assets in the prior fiscal year. We use industry-adjusted leverage ratio, which is the difference between a firm's leverage ratio and the median leverage ratio of all firms with the same industry. Fama-French 48-industry classification is used. Essentially we use the industry median as a proxy for firms' target leverage.

Under the takeover avoidance hypothesis (Denis, 1990; Bagwell, 1991; Brown and Ryngaert, 1991), a potential target firm can make it costlier for potential rival management teams to acquire shares in the firm by repurchasing stock (in the presence of an upward sloping supply curve for shares). We construct a dummy variable, takeover. It is equal to one if the firm is a target of a takeover attempt or if there is a rumor of a takeover attempt in the current or the prior year, and it is set to be zero otherwise. We extract the information on takeovers from SDC Platinum Database of Mergers and Acquisitions.

According to the management stock option dilution hypothesis, a share buyback can reduce the dilution effect from option exercise (e.g., Fenn and Liang, 2001; Kahle, 2002). Management stock options are not dividend-protected, giving them a clear preference for repurchases over dividends. Fenn and Liang (2001) find a supporting positive relationship between repurchases and management

[4] 19% of the firm-year observations report negative net income, out of which 71% do not pay dividend. For those paying dividend in spite of negative net income, we set the dividend payout ratio to be missing, which is about 5% of the total sample. For robustness test, we also compute dividend payout ratio as the dividend paid divided by sales, and the results do not change.

stock options. Following Fenn and Liang (2001), we scale the number of shares underlying options (including both exercisable and unexercisable options) held by managers by the number of shares outstanding. The managers are the top five executives as recorded in Execucomp database, and the information on exercisable and unexercisable stock options are obtained from Execucomp.

The signaling or undervaluation hypothesis (see, e.g., Vermaelen, 1981; John and Williams, 1984, Brennan and Thakor, 1990; and Lucas and McDonald, 1996) argues that firms may use stock repurchases to signal the undervaluation of their equity. Dittmar (2000) and other studies use market-to-book ratio and prior-year abnormal stock return as proxies of misvaluation. We include these two variables in our analysis as well. As computed in Dittmar (2000), market-to-book is the ratio of market value of equity plus debt to the book value of assets at the end of the prior fiscal year. Abnormal return is the market-adjusted abnormal return for the one year prior to the beginning of the current fiscal year. We use CRSP monthly data to obtain stock return. We also include firm size (measured as total assets) to control for any size effect.

3.4 Descriptive statistics

Table 2 provides preliminary statistics of firm characteristics, CEO compensation, and the magnitude of share repurchases. All dollar amounts are adjusted to 1992 dollars by using the consumer price index (CPI).[5] Panel A summarize the variables in the whole sample. Bonus is a significant portion of CEO income. It is about 31% (mean) or 34% (median) of the cash compensation (the sum of salary, bonus, and other annual pay). Total assets, abnormal return, one-year return to shareholders, management options, and bonus have large outliers. Therefore, in our multivariate analysis, we winsorize these variables at the 1st and 99th percentiles to reduce potential impact caused by a few outliers.

Insert Table 2

[5] CPI data is taken from the website of Bureau of Labor Statistics: http://www.bls.gov/cpi/.

Forty-five percent of the firm-year observations have positive net repurchases. In Figure 4, we plot the percentage of firms in our sample with positive net repurchases by year. Overall, the fraction of repurchasing firms increases over time. In fiscal year 1993, 39% of the firms have positive net repurchases. By contrast, in fiscal year 2007, more than 64% of the firms have positive net repurchases.

Insert Figure 4

In Panel B of Table 2, we compare firm characteristics and CEO bonus compensation between repurchasing and non-repurchasing firms, and present tests of differences in the means and medians. Repurchasing firms are larger, have smaller cash holdings despite greater profitability, greater payout ratio, lower leverage and industry-adjusted leverage ratio, and lower market-to-book than non-repurchasing firms.

Note that, on average, repurchasing firms have lower management options than non-repurchasing firms. It seemingly contradicts the positive relationship between repurchases and management options as documented by Fenn and Liang (2001). However, repurchasing firms are also significantly larger than non-repurchasing firms and firm size is negatively related to management options. In the multivariate analysis, controlling for firm size and other firm characteristics, we observe the expected positive relation between repurchases and management options.

The probability of being the target of a takeover attempt in the current or the prior year is about the same between the two groups. The CEOs in the repurchasing firms receive a larger bonus than those in non-repurchasing firms, although repurchasing firms have smaller one-year returns in the current year than non-repurchasing firms.

The average amount of buyback by repurchasing firms is $173.91 million, and the average buyback ratio is 3.49%. This is economically significant: assuming that EPS without repurchase is about $3/share (the average reported EPS is $3.84/share in the sample), a 3.49% reduction in the number of shares outstanding will increase EPS by 11 cents per share. This translates to a significant

payoff for CEOs. For example, Wendy's International Inc., in its proxy for fiscal year 1999, discloses that, for every one cent increase in earnings per share, its CEO will receive up to $12,500 in annual bonus. Another example, Watsco, Inc., in its proxy for fiscal year 2006, explicitly specifies that, for every one cent increase in earnings per share, its CEO will be awarded $65,250 in annual bonus, conditional on the threshold EPS goal being met.

Panel C of Table 2 presents the Pearson correlation coefficients between the buyback ratio and the explanatory variables of repurchasing. The buyback ratio is positively related to firm size, profitability, probability of being taken over, and management options. It is negatively related to leverage, market-to-book ratio, and abnormal return. The univariate patterns are generally consistent with the results as documented by the prior literature.

In Panel D of Table 2, we report the Pearson correlation coefficients between the dollar amount of CEO bonus and firm characteristics. The level of CEO bonus is positively related to the dollar amount of buyback (correlation coefficient is 0.20) and the buyback ratio (correlation coefficient is 0.07). It is also positively related to the one-year return to shareholders (correlation coefficient is 0.07). The correlation between firm size (total assets) and bonus is also positive and significant (correlation coefficient is 0.38). Given that the repurchasing firms are larger, one cause for the difference in the bonus between repurchasing and non-repurchasing firms (Panel B) may be firm size. In Section 4.2, we will use multivariate analysis to show that, when CEO bonus is tied to EPS, repurchasing does have an impact on CEO bonus, controlling for firm size and other factors.

4. Empirical analysis and results

We now test the hypotheses we developed in Section 2. First, we investigate whether a firm is more likely to undertake share repurchases if its CEO's bonus is tied to EPS. Second, we examine how share repurchases affect CEO bonuses, in terms of the probability of receiving a bonus and the magnitude of the bonus. Third, we test whether firms are more likely to conduct share repurchases

when their EPS is close to the level that triggers the bonus. Finally, we examine whether EPS-motivated repurchases are different: do they have lower long-run returns?

4.1 Share repurchases and the tie of CEO bonus to EPS

We study whether the tie of CEO bonus to EPS has an impact on share buyback. In Table 3, we start by comparing the frequency of buyback, the dollar amount of buyback, and the buyback ratio in the two groups: those tying EPS to CEO bonus and those not. In the group with CEO bonus tied to EPS, the frequency of buyback is 52%, significantly higher than the 41% found in the counterpart group. The dollar amount and relative size of buyback are also significantly greater in the former group than the latter.

Insert Table 3

We then conduct a multivariate analysis of repurchasing with the tie to EPS as one of the explanatory variables. We estimate a tobit regression of share buyback ratio as the following:

$$Buyback_{i,t} = \beta_0 + \beta_1 Size_{i,t-1} + \beta_2 profitability_{i,t-1} + \beta_3 Cash_{i,t-1} + \beta_4 Pay_{i,t-1} + \beta_5 IndLever_{i,t-1} + \beta_6 Takeover_{i,t-1} + \beta_7 MTB_{i,t-1} + \beta_8 AbRet_{i,t-1} + \beta_9 MO_{i,t} + \beta_{10} Negative_{i,t} + \beta_{11} EPSfactor_{i,t} + \mu_{i,t} \quad (1)$$

We also estimate a probit model of whether the net repurchase is positive:

$$Buy_{i,t} = \gamma_0 + \gamma_1 Size_{i,t-1} + \gamma_2 profitability_{i,t-1} + \gamma_3 Cash_{i,t-1} + \gamma_4 Pay_{i,t-1} + \gamma_5 IndLever_{i,t-1} + \gamma_6 Takeover_{i,t-1} + \gamma_7 MTB_{i,t-1} + \gamma_8 AbRet_{i,t-1} + \gamma_9 MO_{i,t} + \gamma_{10} Negative_{i,t} + \gamma_{11} EPSfactor_{i,t} + \varphi_{i,t} \quad (2)$$

In Equation (1) and Equation (2), *Negative* is one if the earnings are not positive; and zero otherwise. We include *Negative* because, if the earnings are not positive, a repurchase will not increase EPS. Thus CEOs would be less likely to repurchase when the net income is zero or negative. *EPSfactor* is one if the CEO's bonus is directly tied to earnings per share, and zero otherwise. The rest of the independent variables are: log of total assets (*Size*), profitability (*profitability*), cash holdings (*Cash*), dividend payout ratio (*Pay*), industry-adjusted leverage ratio (*IndLever*), takeover dummy (*Takeover*), market-to-book (*MTB*), abnormal return (*AbRet*), and management options (*MO*). They are used to test the five hypotheses regarding firms' rationale for share buyback: the distribution of excess cash hypothesis, the target leverage-ratio hypothesis, the takeover avoidance hypothesis, the

signaling or undervaluation hypothesis, and the management stock option dilution hypothesis. We also control for year and industry fixed effects in the estimation of Equation (1)-(2).

The estimated coefficients and standard errors are presented in Table 4. Panel A contains the results from the tobit regression of Equation (1), and Panel B displays the results from the probit regression of Equation (2). In both panels, Column (1) excludes the firms who do not have a bonus plan or do not provide information on whether EPS is a factor in bonus award, while Column (2) includes all the firms. For robustness check, we exclude firms with negative earnings from the samples in Column (1) and Column (2), and report the results in Column (3) and (4) respectively. We compute the standard errors in the regressions by clustering the observations by firm (Petersen, 2009). These standard errors are also robust to heteroskedasticity.

Insert Table 4

Firm size is a positive and significant determinant of the buyback ratio (Panel A) and the probability of share repurchasing (Panel B). Both profitability and cash holdings have positive and significant coefficients on the buyback ratio and the probability of buyback, supporting the distribution of excess cash hypothesis. Industry-adjusted leverage ratio has a significant and negative coefficient in both panels, supporting the target leverage ratio hypothesis. Both market-to-book and abnormal return are negative and significant determinants of the buyback ratio and the probability of buyback, supporting the undervaluation hypothesis. The management stock option variable is significant and positive in both panels, consistent with findings in Fenn and Liang (2001). As expected, when earnings are not positive, firms are less likely to conduct a share buyback. Excluding firms with negative or zero earnings has little effect on the results.

The variable of interest is the tie of CEOs' bonus to EPS. In Panel A, we find that the tie of CEO bonus to EPS affects the scaled share buyback positively and significantly. Tying the CEO's bonus to EPS would increase the scaled share buyback by 0.5%, which is about one third of the sample mean (the sample mean of scaled buyback is 1.59%, as shown in Panel A of Table 2). In Panel B, the tie of

CEO bonus to EPS significantly increases the probability of a firm having positive net repurchases. The evidence in Table 4 supports the first part of Hypothesis 1: when its CEO's bonus is tied to EPS, a firm is more likely to repurchase shares.

4.2 Endogeneity of EPS linking

We now compare the two groups of firms: those with CEO bonus linked to EPS and those not. In addition to the financial characteristics such as total assets, cash, leverage, etc., we collect information on corporate governance measures, which are indicators of managerial power. The first one is related to the antitakeover provisions. Gompers, Ishii, and Metrick (2003) construct the so-called "GIndex" using a total of 24 possible antitakeover provisions. Investor Responsibility Research Center (IRRC) database provides annual information on corporate antitakeover provisions for the years 1990, 1993, 1995, 1998, 2000, 2002, 2004, 2006, and 2008. We fill in observations in the missing years using information from the most recent year with data, for example, we use information from 2006 for year 2007. A greater value of GIndex corresponds to weaker shareholder rights and stronger managerial power.

The second measure of governance relates to external monitoring, proxied by institutional ownership. We compute the institutional ownership as the ratio of shares owned by the institutions divided by the total number of shares outstanding. The data source is the Thomson Financial Institutional Ownership database. Greater institutional ownership may provide better monitoring and mitigate the problems associated with managerial opportunism (Shleifer and Vishny, 1986; Jensen, 1993).

In Table 5, we compare the characteristics of the two groups. The EPS-linking firms are larger and have smaller cash holdings, greater profitability, higher payout ratio, higher market-to-book, and greater leverage ratio, than non-EPS-linking firms. EPS-linking firms have higher GIndex and lower institutional holdings than non-EPS-linking firms, suggesting that EPS-linking firms have weaker corporate governance than non-EPS-linking firms.

Insert Table 5

The EPS-linking firms are indeed different from the non-EPS-linking firms. The self-selection of the firms into the different bonus contracts creates an endogeneity problem: treating the EPS factor as exogenous would generate biased estimates from Equation (1)-(2). To deal with the endogeneity issue, we employee two methods to control for the self-selection of EPS linking: the two-step procedure recommended by Wooldridge (2002, Chapter 18) and a propensity score matching approach (LaLonde, 1986; Doyle, Ge, and McVay, 2007; Francis and Lennox, 2008).

In the two-step procedure, we first estimate a probit model of whether CEO bonus is based on EPS, and then use the derived probability (the propensity score) as an instrument for the dummy of EPS factor in the tobit and probit analysis of repurchasing. By this procedure, we control for the endogeneity of the EPS factor.

In the first stage, the probit regression includes the two measures of corporate governance, in addition to all the other independent variables in the analysis of repurchasing, such as natural log of total assets, cash, profitability, payout ratio, industry-adjusted leverage, market-to-book, etc. Panel A of Table 6 reports the estimated coefficients and standard errors from the probit regression. Larger firms with greater profitability, less cash holdings, higher market-to-book, and more management options are more likely to use EPS as a determining factor in CEO bonus. Greater GIndex and smaller institutional holding increase the probability of linking CEO bonus to EPS.

Insert Table 6

Based on the above probit analysis, we derive the propensity score of linking CEO bonus to EPS, which is then used as the instrument for the dummy of EPS factor in the tobit and probit regressions of share repurchase. This approach is different from the common practice used in the literature, which is to replace the endogenous binary variable with the propensity score in the second step. There are

potential problems associated with the common practice, as discussed by Wooldridge (2002).[6] For comparison, we also follow the common practice of replacing the EPS factor with the propensity score in the tobit and probit regressions of share repurchase.

Panel B of Table 6 reports the estimated coefficients and standard errors obtained from the tobit (Column 1 and 2) and probit (Column 3 and 4) regressions of share repurchasing in the second step. In Column 1 and 3, the propensity score derived from the first step replaces the dummy of EPS factor. In Column 2 and 4, the propensity score derived from the first step is used as the instrument variable for the dummy of EPS factor. The propensity score of EPS linking has a positive and significant impact on both the buyback ratio and the probability of buyback. The instrumented EPS linking also has a significant and positive impact on both the buyback ratio and the probability of buyback.

In the two-step analysis, the two measures of corporate governance are included in the selection model (the probit regession of EPS linking), but not in the regressions of share repurchase. That is, we use the two variables as instruments for whether EPS is a factor in bonus determination. The valid instruments should determine EPS linking (the validity requirement), but are uncorrelated with the error term in the regressions of share repurchasing (the exclusion restrictions). The first-stage probit analysis demonstrates that the two measures of corporate governance are significant determinants of EPS linking, but it is not feasible to directly test if they are uncorrelated with the error term in the regressions of share repurchasing. In theory, exclusion restrictions are not necessary in the two-step selection model such as ours because the model is identified by non-linearity (Li and Prabhala, 2006). However, in practice, the identification issue is less clear cut.

To avoid the issue of exclusion restrictions in the two-step procedure, we now turn to the propensity score matching approach used by LaLonde (1986), Doyle, Ge, and McVay (2007) and Francis and Lennox (2008). An important advantage of the matching technique is that the exclusion

[6] Two of the problems are: inconsistent estimation if the probit model in the first step is misspecified, and no known efficiency properties.

restrictions are unnecessary because the regression of the share repurchase does not include the derived probability from the probit analysis of EPS linking as a control variable.

We implement the matching procedure as following: first, we estimate the probit model of EPS linking for each sample year; we then predict the propensity for the firm to link CEO bonus with EPS and we sort the sample by the predicted probabilities (propensity score); for each EPS-linking firm, we find a non-EPS-linking firm with the closest propensity score; finally, we estimate the probit and tobit models of share repurchasing using the matched-pair sample. This method creates a non-EPS-linking control sample with the same predicted probabilities of linking CEO bonus to EPS as the EPS-linking sample, and thus controls for the self-selection caused by underlying firm characteristics.

Panel C of Table 6 reports the estimated coefficients and standard errors obtained from the tobit (Column 1) and probit (Column 2) regressions of share repurchase on the matched-pair sample. The propensity score matching method produces results similar to those in Table 4. The EPS factor dummy is positive and significant.

The results in Table 6 confirm what we have observed from the tobit and probit analysis of share repurchase in Table 4: controlling for other firm characteristics, firms are more likely to conduct repurchases when their CEO's bonus is tied to EPS.

4.3 The gains of CEOs from share repurchase

We now examine whether CEOs achieve personal gains from share repurchases, when their bonus is tied to EPS. We study the firms whose CEO's bonus is tied to EPS and compare them to those whose CEO's bonus is not tied to EPS. We exclude the firms for which we cannot decide whether EPS is a factor in determining their CEO's bonus and we delete firms who do not have a bonus plan for their CEO.

In the OLS regressions of CEOs' bonus, we have the following specification:

$$CEOBonus_{i,t} = \lambda_0 + \lambda_1 Size_{i,t} + \lambda_2 \mathrm{Re}t_{i,t} + \lambda_3 Buyback_{i,t} + \lambda_4 EPSfactor_{i,t} + \lambda_5 EPSfactor_{i,t} * Buyback_{i,t} + \delta_{i,t} \quad (3)$$

CEOBonus is measured two ways: the natural log of (1+bonus), and the ratio of bonus to (bonus + salary). *Size* is the natural log of the total assets, and *Ret* is the one-year return to the shareholders. *Buyback* is measured in three ways: whether the net repurchase is positive, log of (1+net repurchase), and net repurchase scaled by market value of equity. *EPSfactor* is the indicator of whether EPS is a factor affecting CEO bonus: it is one if the CEO's bonus is tied to earnings per share, and zero otherwise. Equation (3) includes the interaction term between *EPSfactor* and the buyback measure. For firms whose CEO's bonus is not tied to EPS, λ_3 measures the impact of a buyback on CEO bonus. For firms whose CEO's bonus is tied to EPS, $\lambda_3 + \lambda_5$ captures the impact of a buyback on CEO bonus. We also control for year and industry fixed effects in the estimation of Equation (3).

The estimated coefficients and standard errors are presented in Panel A of Table 7. Larger firms award a larger bonus to their CEOs than smaller firms do. Higher stock return is associated with a greater bonus, consistent with the positive pay-performance relation documented in the literature. None of the three buyback measures has a significant coefficient on the level of bonus, i.e., λ_3 is not statistically different from zero. Thus, buyback alone, when the CEO's bonus is not tied to EPS, is not related to the level of the bonus. However, the interaction term between the indicator of CEO bonus being tied to EPS and the buyback measure is positive and significant. F-tests reported at the bottom of the table confirm that $\lambda_3 + \lambda_5$ is positive and significant in Column (1)-(3). Thus, when CEO bonus is tied to EPS, share repurchasing increases the level of CEO bonus. The lack of significance for buyback alone helps mitigate concerns about endogeneity, whereby bonuses and buybacks would be associated due to their potential mutual association with performance.

The impact of share buyback on the level of bonus is economically significant when CEO bonus is tied to EPS: in Column 1, $\lambda_3 + \lambda_5$ equals 0.36, which means that conducting share buyback increases the level of bonus by approximately 43% (that is, exp(0.36)-1) when CEO bonus is tied to EPS; in Column 2, $\lambda_3 + \lambda_5$ equals 0.091, suggesting that an increase of one standard deviation in the

log of buyback amount (the standard deviation is 2.15) increase the level of bonus by about 19% when CEO bonus is tied to EPS; in Column 3, $\lambda_3 + \lambda_5$ equals 4.16, meaning that an increase of one standard deviation in the scaled buyback (the standard deviation is 0.03) increases the level of bonus by about 12% when CEO bonus is tied to EPS.

The analysis of the ratio of bonus to the sum of cash and bonus generates similar results (Column 4-6). Buyback alone, when the CEO's bonus is not tied to EPS, is not related to the ratio of bonus to the sum of salary and bonus. However, the interaction term between the indicator of CEO bonus being tied to EPS and the buyback measure is positive and significant. F-tests at the bottom of the table confirm that $\lambda_3 + \lambda_5$ is positive and significant in Column (4)-(6).

Insert Table 7

Further, we estimate a probit model of whether a CEO receives a bonus. The regression is specified as the following:

$$\begin{aligned} Bonus_{i,t} &= \eta_0 + \eta_1 Size_{i,t} + \eta_2 \mathrm{Re}t_{i,t} + \eta_3 Buyback_{i,t} + \eta_4 EPSfactor_{i,t} \\ &+ \eta_5 EPSfactor_{i,t} * Buyback_{i,t} + \varphi_{i,t} \end{aligned} \quad (4)$$

The dependent variable, $Bonus_{i,t}$, takes the value of one if a firm grants a cash bonus to its CEO in year *t*, and zero otherwise. The independent variables are the same as specified in Equation (3), including firm size, one-year stock return, the three buyback measures, the indicator of CEO bonus being tied to EPS, and its interaction term with one of the three buyback measures. We also control for year and industry fixed effects.

Panel B of Table 7 provides the estimated coefficients and standard errors from the probit regression. The results are consistent with those in Panel A. Share repurchasing does not affect the probability of a CEO receiving a bonus if his bonus is not tied to EPS. However, the interaction term between the indicator of CEO bonus being tied to EPS and the buyback measure is positive and significant. F-test confirms that the overall impact of share repurchasing ($\eta_3 + \eta_5$) is statistically

positive in each of the three columns. Thus, a share buyback increases the probability of CEO being awarded a bonus, but only when his bonus is tied to EPS.

In the OLS regression of CEO bonus, we use share repurchases as one of the independent variables. However, share buyback is an endogenous choice. As we show in Table 2 (Panel B), repurchasing and non-repurchasing firms are different along a number of dimensions, in additional to firm size and stock return. We utilize the method of propensity score matching to control for the differences between non-repurchasing firms and firms with positive net repurchases. First we estimate a probit regression of whether a firm conducts a share buyback, as specified in Equation (2). After the probit regression, the expected probability of having positive share repurchases, i.e., the propensity score, is derived based on the estimated coefficients. For each repurchasing firm, we find a non-repurchasing firm in the same industry and year with the closest propensity score. Last, we compare CEO bonuses between firms with positive buyback and their matching non-repurchasing firms.

Insert Table 8

Table 8 summarizes the mean and median bonus received by CEOs in firms with positive net repurchases versus their propensity-score-matching non-repurchasing firms. We differentiate the group of firms with CEO bonus tied to EPS from the group of firms whose CEO's bonus is not determined by EPS. We find that, within the former group, firms with positive net repurchases grant a greater bonus to their CEO than their matches. However, for the repurchasing firms whose CEO's bonus is not determined by EPS, their CEO does not receive more bonus than the CEO in their propensity score matched firms.

The results in Table 7 and Table 8 reinforce the support for Hypothesis 1: when bonus award is based on EPS, CEOs in firms with positive net repurchases receive more bonus than those in non-repurchasing firms, after controlling for various firm characteristics. The group of firms whose CEO's bonus is not determined by EPS provides a useful benchmark: share repurchase has no significant

impact on the CEO's bonus when EPS is not a factor in the bonus structure. The evidence confirms the idea that the bonus structure can create a personal motivation for CEOs to initiate share buyback.

4.4 Share repurchases and the threshold earnings per share

For the repurchasing firms, we compute what their EPS would have been without the repurchases, that is, the "As-if" EPS, as follows:

$$\textit{As-if EPS 1} = \textit{Earnings}_t / (\textit{Weighted average shares outstanding}_t + 0.5 * \textit{Shares bought}_t)$$

$$\textit{As-if EPS 2} = (\textit{Earnings}_t + 0.5 * \textit{Cost}_t) / (\textit{Weighted average shares outstanding}_t + 0.5 * \textit{Shares bought}_t)$$

$\textit{Earnings}_t$ is the reported income available to common shareholders in year *t, Weighted average* $\textit{shares outstanding}_t$ is the number of shares outstanding used to compute the EPS reported by the company, as provided by COMPUSTAT. $\textit{Shares bought}_t$ is the number of shares bought during the fiscal year, computed as the dollar amount of net repurchase divided by the monthly average stock price. We assume that the shares are bought back uniformly over the year. $\textit{Cost}_t$ is the "opportunity cost", that is, what the company could have earned otherwise from the money they spend on share repurchases. The "opportunity cost" is estimated as the product of the buyback dollar amount and the annualized 3-month Treasury-bill rate.

As we have mentioned before, the majority of firm-year observations use basic EPS, while some use diluted EPS as the threshold EPS for CEO bonus. We compute *As-if EPS 1* and *As-if EPS 2* accordingly, in order to compare them with the threshold EPS consistently.[7]

We compare *As-if EPS 1* and *As-if EPS 2* with the reported EPS (with buyback) by repurchasing firms. We find that the reported EPS, on average, is 12 cents higher than *As-if EPS 1* and 9 cents higher than *As-if EPS 2* (not tabulated). To test whether firms are more likely to conduct share repurchases when their earnings per share are close to the level that triggers the bonus (Hypothesis 2),

[7] For basic EPS, COMPUSTAT provides earnings (data 237) and weighted average shares outstanding (data 54) that are used to calculate basic EPS; for diluted EPS, COMPUSTAT provides weighted average shares outstanding (data 171) that are used to calculate diluted EPS and diluted EPS (data 57), and we compute the earnings as the product of data 171 and data 57.

we include non-repurchasing firms in the analysis. For the non-repurchasing firms, *As-if EPS 1* and *As-if EPS 2* are the same as the reported EPS.

If *As-if EPS 1* or *As-if EPS 2* is less than but within 15% of the threshold earnings per share, we say that the *As-if EPS* is close to the threshold. We also use 10% and 20% as the cutoff, and the results are qualitatively the same.

In Table 9, we compare the frequency, dollar amount, and relative size of share buyback between those firms with *As-if EPS* close to the threshold EPS and others. Panel A examines *As-if EPS 1* and Panel B *As-if EPS 2*. When *As-if EPS* is close to the threshold earnings per share, 75% of the observations conduct share buyback, significantly higher than the 60% when *As-if EPS* is not close to the threshold earnings per share. In both panels, the amount of buyback and the buyback ratio are significantly higher when *As-if EPS* is close to the threshold earnings per share. The statistic tests confirm the significant difference in median, although the statistical difference in mean between the two subsets is a little weaker. The univariate results in Table 9 support Hypothesis 2: when EPS is close to the level triggering bonus payment, firms are more likely to repurchase shares.

Insert Table 9

In the multivariate analysis, we estimate the tobit model of buyback ratio and the probit model of firms conducting a share buyback incorporating the indicator of whether the *As-if EPS* is close to the threshold earnings per share. The regressions are specified as the following:

The tobit regression:

$$\begin{aligned} Buyback_{i,t} &= \beta_0 + \beta_1 Size_{i,t-1} + \beta_2 \Pr ofitability_{i,t-1} + \beta_3 Cash_{i,t-1} + \beta_4 Pay_{i,t-1} + \beta_5 IndLever_{i,t-1} \\ &+ \beta_6 Takeover_{i,t-1} + \beta_7 MTB_{i,t-1} + \beta_8 Ab\,\mathrm{Re}\,t_{i,t-1} + \beta_9 MO_{i,t} + \beta_{10} Negative_{i,t} + \beta_{11} Close_{i,t} + \mu_{i,t} \end{aligned} \quad (5)$$

The probit regression:

$$\begin{aligned} Buy_{i,t} &= \gamma_0 + \gamma_1 Size_{i,t-1} + \gamma_2 \Pr ofitability_{i,t-1} + \gamma_3 Cash_{i,t-1} + \gamma_4 Pay_{i,t-1} + \gamma_5 IndLever_{i,t-1} \\ &+ \gamma_6 Takeover_{i,t-1} + \gamma_7 MTB_{i,t-1} + \gamma_8 Ab\,\mathrm{Re}\,t_{i,t-1} + \gamma_9 MO_{i,t} + \gamma_{10} Negative_{i,t} + \gamma_{11} Close_{i,t} + \varphi_{i,t} \end{aligned} \quad (6)$$

Note that all the firms in the above regressions have their CEO bonus tied to EPS. *"Close"* is one if the *As-if EPS* is below but within 15% of the threshold earnings per share, and zero otherwise. The

estimated coefficients and standard errors from the regression are presented in Panel A (tobit) and Panel B (probit) of Table 10. In both columns (*As-if EPS 1* in Column 1, and *As-if EPS 2* in Column 2), firm size and profitability are positive and significant determinants. When *As-if EPS 1* or *As-if EPS 2* is close to the threshold EPS, the buyback ratio and the probability of share buyback increase. In the tobit regression, when the As-if EPS is close to the threshold, the buyback increases by 1.4% (*As-if EPS 1*) or 1.3% (*As-if EPS 2*) of the market equity. In the probit regression, the odds ratio for repurchasing given that the firm is close to the threshold EPS is 2.20 (*As-if EPS 1*) and 2.13 (*As-if EPS 2*). Table 10 provides support to Hypothesis 2.

Insert Table 10

4.5 Post-buyback returns

To test Hypothesis 3, we study the three-year post-buyback abnormal returns. We keep the first year of a firm with positive net repurchase, i.e., we drop its subsequent years of repurchases from the sample, to avoid the compounding effects of multiple observations from the same firm. Since we identify a company to be a repurchasing firm if its net repurchase in the fiscal year is positive, we use the last month of the fiscal year as the event month. For each month, we form value-weighted portfolios of firms that have repurchased within the previous three years. The value-weighted monthly returns use the market value of equity at the end of the previous month as the weighting factor. The portfolios are rebalanced monthly so that all companies that reach the end of their three-year period can be dropped and all companies that have just repurchased can be added. Using the calendar-time portfolio approach, we perform the following four-factor regression of monthly returns. We drop the months with less than ten firms to mitigate the heteroskedasticity problem (see, Mitchell and Stafford, 2000). The portfolio excess returns are regressed onto the four factors as introduced by Fama and French (1993) and Carhart (1997).

$$R_{buy,t} - R_{f,t} = \alpha_0 + \alpha_1(R_{m,t} - R_{f,t}) + \alpha_2 SMB_t + \alpha_3 HML_t + \alpha_4 UMD_t + \varepsilon_{p,t} \quad (7)$$

$R_{buy,t}$ is the value-weighted portfolio return of repurchasing firms in month t. $R_{f,t}$ is the return of one-month Treasury bill, $R_{m,t}$ is the return on the CRSP value-weighted portfolio, SMB_t is the difference between returns of value-weighted portfolios of small and big stocks, HML_t is the difference between returns of value-weighted portfolios of high and low book-to-market stocks, and UMD_t is the difference between returns of value-weighted portfolios of high and low momentum stocks. The intercept, α_0, is interpreted as the mean monthly abnormal return.

We also construct a zero-investment (or hedged) calendar-time portfolio consisting of long positions on repurchasing firms and short positions on their matching firms. For each repurchasing firm, we find a matching non-repurchasing firm in the same industry with the closest firm size (measured by total assets). We estimate the regression of the hedged portfolio returns onto the four factors as following:

$$R_{buy,t} - R_{match,t} = \gamma_0 + \gamma_1(R_{m,t} - R_{f,t}) + \gamma_2 SMB_t + \gamma_3 HML_t + \gamma_4 UMD_t + \eta_{p,t} \cdot \quad (8)$$

$R_{buy,t}$ is the value-weighted portfolio return of repurchasing firms in month t; $R_{match,t}$ is the value-weighted portfolio return of matching non-repurchasing firms in month t. γ_0 is interpreted as the mean monthly abnormal return.

The above analysis is also done for the two subsets of firms: those with CEO bonus tied to EPS, and those whose CEO bonus is not determined by EPS. The estimated coefficients and standard errors are reported in Table 11. Panel A uses the sample of all repurchasing firms. Panel B uses the subset of repurchasing firms with CEO bonus tied to EPS, and Panel C the subset of repurchasing firms whose CEO bonus is not tied to EPS.

Insert Table 11

For the sample of all repurchasing firms, the intercepts, α_0 and γ_0 are positive and significant at 10% level, suggesting that the repurchasing firms make positive abnormal returns and they outperform

their matching non-repurchasing firms in the post-buyback periods. α_0 is 0.31%, which translates to a mean annual abnormal return of 3.7%. γ_0 is 0.42%, which means that the repurchasing firms outperform the match firms by 5.0% annually. The results are qualitatively consistent with Ikenberry, Lakonishok, and Vermaelen (1995), although our data period and methodology are different from theirs.

For the subset of the firms with CEO bonus determined by EPS, α_0 and γ_0 are 0.07% and 0.18% respectively, not statistically significant. By contrast, for the subset of the firms with CEO bonus not tied to EPS, α_0 and γ_0 are 0.49% (significant at 1% level) and 0.60% (significant at 5% level) respectively. These numbers translate to a mean annual abnormal return of 5.88% and 7.20%, respectively.

The above evidence provides support to Hypothesis 3: when CEO bonus is determined by EPS, shares of repurchasing firms do not fare better in the post-buyback period than shares of their matching non-repurchasing firms. Personal gain, rather than undervaluation, is the primary motivation for these repurchases.

5. Additional robustness tests

5.1 Quarterly buyback

Towards the end of a fiscal year, CEOs have more knowledge of whether the EPS will fall short of the threshold. As a result, if EPS-linking motivates the CEOs to conduct buyback, we expect that these firms are more likely to buy back towards the end of the fiscal year. We use COMPUSTAT quarterly data on the repurchasing firms to compute the amount of buyback in each quarter. We calculate the quarterly repurchases as the change in common treasury stock (COMPUSTAT Quarterly #98). If treasury stock is zero in the current and prior quarter, we measure repurchases as the difference between stock purchase (COMPUSTAT Quarterly #93) and stock issuance (COMPUSTAT Quarterly #84). We then compute the ratio of buyback in each quarter to the total amount in the whole

fiscal year. Table 12 reports the mean and median of the quarterly buyback ratio, for EPS-linking and non-EPS-linking firms.

Insert Table 12

For EPS-linking firms, the fourth quarter sees greater buyback activity than earlier quarters. A Kruskal-Wallis test confirms the statistical significance of the differences among the four quarters. For non-EPS-linking firms, there are no statistically significant differences among the four quarters.

5.2 Equity-based compensation of CEOs

CEOs' equity-based compensation gives them incentives to manipulate earnings (e.g., Bergstresser and Philippon, 2006). Would equity-based compensation also motivate them to conduct a buyback and thus increase earnings per share? In the earlier analysis, we consider management options, i.e., the number of shares underlying options held by the top five executives scaled by the number of shares outstanding, as one factor in share buyback decisions. However, stock option holdings are noisy measures of managerial incentives as they do not explicitly measure the relation between CEO portfolio wealth and stock returns. We now examine the effects of CEO portfolio delta on their incentives to buy back shares. Delta is defined as the dollar change in a CEO's stock and option portfolio for a 1% change in stock price, and we compute delta using the one-year approximation method outlined in Core and Guay (2002). The information needed for the calculation of delta is obtained from Execucomp (B-S volatility, individual option grants, etc.) and Federal Reserve Bank Reports (the risk-free rates).

The mean and median CEO portfolio delta in our sample are $881,122 and $249,661, respectively. That is, for 1% increase in stock price, the CEO's wealth tied to stock and option, on average, increases by more than $880,000. In untabluated tests, we find that our original management options variable is highly correlated with the managerial delta, such that managerial delta does not add anything new to the buyback regressions and does not change the EPS-linking results.

5.3 Discretionary accruals

It is natural to ask whether managers using repurchases to manipulate the denominator also use discretionary accruals to manipulate the numerator of EPS. To answer the question, we estimate an OLS regression of earnings discretionary accruals with year and industry fixed effects. The model is as following:

$$DA_{i,t} = \beta_0 + \beta_1 Size_{i,t-1} + \beta_2 MTB_{i,t-1} + \beta_3 EPSfactor_{i,t} + \mu_{i,t}$$

DA is the discretionary accruals that are derived via the modified Jones' model (Jones, 1991; Roychowdhury, 2006).[8] The estimated coefficient on EPSfactor is 0.001 with a standard error of 0.003. EPS-linked bonuses by themselves do not lead to greater discretionary accruals. We further test whether greater discretionary accruals are associated with greater repurchases. We examine the correlation between buyback ratios and discretionary accruals. The Pearson correlation coefficient between them is -0.012, with p-value being 0.136. Thus, if anything, greater accruals are associated with lower repurchases. This is sensible as greater accruals means that less of the firm's earnings represent actual cash flow that could be used for repurchases.

6. Conclusion

We investigate the direct financial incentives CEOs have to initiate repurchases. By mechanically increasing current-year EPS, repurchases provide a means for CEOs to increase their EPS-driven bonuses. In a hand-collected sample of more than 12,000 firm-years, we find support for the hypotheses that CEOs with EPS-based bonuses are more likely to repurchase and that the closer they

[8] We estimate the model of accrual: $Accruals_t/A_{t-1} = \alpha_0 + \alpha_1 (1/A_{t-1}) + \beta_1 (\Delta S_t/A_{t-1}) + \beta_2 (PPE_{t-1}/A_{t-1}) + \varepsilon_t$. *Accruals* are income before extraordinary items (COMPUSTAT data#18). ΔS is the change in sales (data#12). *PPE* is the net property, plant, and equipment (data#8). All variables other than the first intercept are scaled by lagged total assets (data#6). The regressions are estimated for firms in every industry-year, with industries defined by two-digit SIC codes. The residuals are the discretionary accruals.

are to their EPS bonus threshold, the greater is the effect. Hence, this study provides the link between share purchase and CEO's private financial benefit.

Our findings add to the literature linking earnings management and compensation as well as the literature establishing the influence of compensation on payout policy. Healy (1985) was the first to show that CEOs appear to manage earnings to meet bonus criteria. Our paper extends his work by showing that with the rise of stock repurchases, CEOs now expend corporate liquidity on payout actions with the aim of manipulating bonus payouts. We further extend the literature establishing that the design of CEO compensation influences payout policy. Earlier work in this area (e.g. Fenn and Liang, 2001) has shown that option compensation creates a preference for repurchases over dividend because options are not dividend-protected. Our study shows that EPS-linked bonuses create an incentive to initiate a repurchase even in the absence of managerial options.

Appendix: **Some proxy excerpts regarding the effect of repurchasing on EPS-linked bonuses**

We first searched for keywords, "repurchase", "repurchasing", or "share buyback", in the proximity of "EPS", "earnings-per-share", or "earnings per share" in the 6,125 proxies that link CEO bonus to EPS, and then we read the proxy if the computer located "repurchase", "repurchasing", or "share buyback", within a 100-word range from "EPS", "earnings-per-share", or "earnings per share" in that proxy. We found that in only 30 proxies (less than 0.5% of the 6,125 proxies), the firm's compensation committee talked about the impact of repurchase on EPS.

Among the 30 proxies, only 7 stated that they might adjust the impact of repurchase when deciding whether EPS goal is achieved. For example, Pepsi Bottling company, in the proxy filed on 04/10/2008, says "*For our business and industry, we believe the most relevant criteria on which to evaluate our success are earnings per share ("EPS"), profit, volume of product sold, and operating free cash flow (as defined in our earnings releases). We view EPS as the best composite indicator of PBG's operational performance. The Committee, therefore, emphasizes EPS in establishing performance targets for the Named Executive Officers. In evaluating our performance against such EPS targets, however, the Committee considers the impact of unusual events on our reported EPS results (e.g., acquisitions, changes in accounting practices, share repurchases, etc.) and may adjust the results for purposes of determining the extent to which the EPS targets were or were not achieved."*

For the majority of the 30 proxies, the compensation committee understands the impact of repurchase on EPS, but they do not adjust the impact of repurchase when deciding whether EPS goal is achieved. For example, Energizer, in the proxy filed on 11/29/2007, says, *"Our incentive programs are focused on consistent EPS growth from year to year. The choice of any performance metric involves a consideration of its advantages and drawbacks, and the committee has carefully considered these issues with respect to the use of EPS. The committee has recognized that non-operating factors, in particular our share repurchases over the past five years, have impacted EPS growth, even though the primary component of our EPS growth, historically, has been contributions from operations. We believe our share repurchase program has been an important factor in increasing shareholder value—a practical and tax efficient means of providing shareholder returns—and that our officers should be rewarded for its success. Consequently, the committee believes that it is appropriate to utilize EPS, without adjustment for share repurchases, as our key performance metric. Nevertheless, the committee is regularly advised of share repurchases and other discretionary management actions which can impact EPS growth. The committee also periodically considers the impact of our focus on EPS improvement on operational and cash management decisions."*

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Table 1: Summary of the bonus structure of CEOs

Panel A summarizes the frequency of whether EPS is a factor in determining CEO bonus. The information is collected from proxy statements (DEF 14A) available on SEC website, starting from 1994. Panel B reports the within-firm one-year transition probabilities of EPS linking.

Panel A: The distribution frequency of whether EPS is a factor in determining CEO bonus

	Number of observations	Frequency
There is no bonus component in CEO compensation	283	2.27%
Cannot determine	2,357	18.87%
EPS is not a factor in CEO bonus	3,711	29.75%
EPS is a factor in CEO bonus	6,125	49.00%
Total	12,476	100%

Panel B: The one-year within-firm transition matrix

	There is no bonus component in CEO compensation	Cannot determine	EPS is not a factor in CEO bonus	EPS is a factor in CEO bonus
There is no bonus component in CEO compensation	86.85%	5.98%	3.59%	3.59%
Cannot determine	0.29%	76.22%	10.86%	12.63%
EPS is not a factor in CEO bonus	0.16%	6.06%	86.51%	7.28%
EPS is a factor in CEO bonus	0.11%	3.22%	3.87%	92.80%

Table 2: Preliminary statistics of firm characteristics, CEO bonus, and share repurchase

This table provides preliminary statistics on firm characteristics, CEO compensation, and magnitude of share repurchase. We calculate the net repurchase as the increase in common treasury stock (Compustat #226). If treasury stock is zero in the current and prior year, we measure repurchases as the difference between stock purchase (#115) and stock issuance (#108). If either of these two amounts is negative, repurchases are set to zero. All dollar amounts are in 1992 dollars. *Cash* is the amount of cash and cash equivalents scaled by the book value of assets. *Profitability* is the ratio of net income to the total assets. *Payout ratio* is the dividend paid scaled by net income. *Leverage* is the sum of long-term debt and debt in current liabilities scaled by the book value of assets. *Industry-adjusted Leverage* is the difference between a firm's leverage ratio and the median leverage ratio of all firms with the same industry (Fama-French 48-industry classification is used). *Takeover* is one for firms that are targets of acquisition attempts or rumor of acquisition attempts in the current or the prior fiscal year, and zero otherwise. *Market-to-book* is the market value of equity plus debt to the book value of assets. *Abnormal return* is the market-adjusted abnormal return within one year prior to the beginning of the current fiscal year. *Management options* is the number of shares underlying options held by the top five executives scaled by the number of shares outstanding. *Cash pay* is the sum of salary, bonus, and other annual income. Panel A summarizes the variables, Panel B compares repurchasing versus non-repurchasing firms, Panel C presents the Pearson correlation coefficients between buyback ratio and firm characteristics, and Panel D reports the Pearson correlation coefficients between CEO bonus and firm characteristics.

Panel A: Summary of variables in the whole sample

	Number of observations	Mean	Median	Standard deviation	1% cutoff	99% cutoff
Total assets ($mil.)	12,476	4,112	831	19,072	48	40,820
Cash	12,397	0.15	0.07	0.17	0.0005	0.75
Profitability	12,395	0.04	0.05	0.17	-0.50	0.26
Payout ratio	11,703	0.17	0	0.26	0	1
Leverage	12,359	0.21	0.20	0.16	0	0.62
Industry-adjusted leverage	12,359	0.05	0.03	0.16	-0.26	0.49
Takeover	12,476	0.01	0	0.11	0	1
Market to book	12,359	1.96	1.39	2.55	0.43	9.47
Abnormal Return	12,075	8.95%	-0.59%	60.31%	-88.03%	309.00%
One-year return to shareholders	12,153	21.62%	9.53%	115.89%	-76.80%	298.11%
Management options	12,153	0.030	0.023	0.038	0	0.124
Dummy of bonus award (=1, if bonus>0; =0, otherwise)	12,476	0.69	1	0.46	0	1
Bonus ($ thousand)	12,476	450.13	208.78	857.80	0	3,515
Bonus divided by cash pay	12,476	0.31	0.34	0.26	0	0.84
Buy=1, if net repurchase>0; =0 otherwise	12,476	0.45	0.00	0.50	0	1
Amount of buyback ($mil.)	12,476	78.83	0.00	432.47	0	1,582
Buyback ratio	12,476	1.59%	0.00	0.16	0%	16%

Panel B: Comparison of repurchasing versus non-repurchasing firms

	Non-repurchasing firms Mean (Median)	Repurchasing firms Mean (Median)	t-test: t-stat (p-value)	Kruskal-Wallis test: Chi-squared (p-value)
Total assets ($mil.)	3,431 (680) n=6,821	4,935 (1,118) n=5,655	4.39 (<0.0001)	287.26 (<0.0001)
Cash	0.16 (0.07) n=6,743	0.13 (0.06) n=5,654	6.83 (<0.0001)	5.65 (0.02)
Profitability	0.01 (0.04) n=6,742	0.07 (0.07) n=5,653	19.28 (<0.0001)	711.06 (<0.0001)
Payout ratio	0.15 (0.00) n=6,263	0.19 (0.08) n=5,440	8.43 (<0.0001)	294.77 (<0.0001)
Leverage	0.22 (0.21) n=6,729	0.19 (0.18) n=5,630	8.79 (<0.0001)	57.65 (<0.0001)
Industry-adjusted leverage	0.06 (0.04) n=6,729	0.04 (0.01) n=5,630	9.97 (<0.0001)	100.78 (<0.0001)
Takeover	0.01 (0.00) n=6,821	0.01 (0.00) n=5,655	0.18 (0.86)	0.03 (0.86)
Market to book	2.01 (1.47) n=6,729	1.90 (1.31) n=5,630	2.44 (0.01)	82.10 (<0.0001)
Abnormal Return	11.65% (-0.35%) n=6,523	5.78% (-0.82%) n=5,552	1.21 (0.27)	5.34 (<0.0001)
One-year return to shareholders	28.59% (12.37%) n=6,596	13.36% (7.45%) n=5,557	7.73 (<0.0001)	41.96 (<0.0001)
Management options	0.031 (0.024) n=6,596	0.028 (0.021) n=5,557	3.92 (<0.0001)	56.90 (<0.0001)
Dummy of bonus award (=1, if bonus>0; =0, otherwise)	0.68 (1.00) n=6,821	0.70 (1.00) n=5,655	2.66 (0.008)	7.07 (0.008)
Bonus ($ thousand)	384.98 (172.15) n=6,821	528.71 (264.56) n=5,655	9.24 (<0.0001)	93.31 (<0.0001)
Bonus divided by cash pay	0.30 (0.32) n=6,821	0.33 (0.38) n=5,655	6.55 (<0.0001)	42.72 (<0.0001)
Amount of buyback ($mil.)	0.00 (0.00) n=6,821	173.91 (21.90) n=5,655	20.78 (<0.0001)	11,086 (<0.0001)
Buyback ratio	0.00 (0.00) n=6,821	3.49% (1.78%) n=5,655	11.50 (<0.0001)	10,995 (<0.0001)

Panel C: Correlation matrix of buyback ratio and firm characteristics

Correlation coefficient (p-value)	Total assets	Cash	Profitability	Payout ratio	Leverage	Industry-adjusted leverage	Takeover	Market to book	Abnormal Return	Management options	Buyback ratio
Total assets	1.0										
Cash	-0.33 (0.0000)	1.0									
Profitability	0.10 (0.0000)	-0.09 (0.0000)	1.0								
Payout ratio	0.29 (0.0000)	-0.24 (0.0000)	0.10 (0.0000)	1.0							
Leverage	0.34 (0.0000)	-0.43 (0.0000)	-0.17 (0.0000)	0.13 (0.0000)	1.0						
Industry-adjusted leverage	0.23 (0.0000)	-0.13 (0.0000)	-0.21 (0.0000)	-0.04 (0.0017)	0.68 (0.0000)	1.0					
Takeover	0.02 (0.02)	0.01 (0.42)	-0.04 (0.0001)	-0.02 (0.08)	0.01 (0.38)	0.05 (0.0000)	1.0				
Market to book	-0.17 (0.0000)	0.39 (0.0000)	0.23 (0.0000)	-0.12 (0.0000)	-0.29 (0.0000)	-0.09 (0.0000)	-0.02 (0.01)	1.0			
Abnormal Return	-0.06 (0.0000)	0.13 (0.0000)	0.09 (0.0000)	-0.10 (0.0000)	-0.07 (0.0000)	-0.03 (0.0013)	-0.01 (0.16)	0.31 (0.0000)	1.0		
Management options	-0.43 (0.0000)	0.16 (0.0000)	-0.13 (0.0000)	-0.26 (0.0000)	-0.05 (0.0000)	0.01 (0.19)	-0.01 (0.25)	-0.01 (0.18)	0.10 (0.0000)	1.0	
Buyback ratio	0.10 (0.0000)	-0.01 (0.11)	0.14 (0.0000)	0.00 (0.92)	-0.04 (0.0000)	-0.02 (0.06)	0.02 (0.01)	-0.06 (0.0000)	-0.05 (0.0000)	0.04 (0.0000)	1.0

Panel D: Correlation matrix of CEO bonus and firm characteristics

Correlation coefficient (p-value)	Bonus	Total assets	One-year return to shareholders	Amount of buyback	Buyback ratio
Bonus	1.0				
Total assets	0.38 (0.0000)	1.0			
One-year return to shareholders	0.07 (0.0000)	-0.03 (0.0004)	1.0		
Amount of buyback	0.20 (0.0000)	0.32 (0.0000)	-0.01 (0.44)	1.0	
Buyback ratio	0.07 (0.0000)	0.08 (0.0000)	-0.04 (0.0000)	0.29 (0.0000)	1.0

Table 3: Share buyback and the tie of CEO bonus to EPS

This table compares the frequency of positive buyback, the magnitude of buyback, and the scaled buyback in two groups: firms where CEO bonus is not tied to EPS versus firms where CEO bonus is tied to EPS. "n" is the number of observations.

	=1, if positive net repurchase; =0, otherwise	The amount of buyback ($ mil.)	Net repurchases scaled by market value of equity (%)
	Mean (median)	Mean (median)	Mean (median)
EPS is a factor in CEO bonus	0.52 (1.00) n=6,125	114.60 (0.14) n=6,125	1.60 (0.02) n=6,125
EPS is not a factor in CEO bonus	0.41 (0.00) n=3,711	43.76 (0.00) n=3,711	1.20 (0.00) n=3,711
t-test: t-stat (p-value)	10.37 (<0.0001)	8.56 (<0.0001)	6.84 (<0.0001)
Kruskal-Wallis test: Chi-squared (p-value)	106.34 (<0.0001)	185.07 (<0.0001)	106.88 (<0.0001)

Table 4: Multivariate analysis of share buyback and the tie of CEO bonus to EPS

In this table, we present the estimated coefficients and standard errors obtained from the tobit regression of scaled net repurchase (Panel A) and probit regression of share buyback (Panel B). In both panels, Column (1) excludes the firms that do not have a bonus plan or that do not provide information on whether EPS is a factor in the bonus award, while Column (2) includes all the firms. Column (3) and column (4) exclude firms with negative earnings from the samples in column (1) and (2) respectively. The numbers in the parentheses are the standard errors. The standard errors are clustered at the firm level, and are also robust to heteroskadesticity.

The tobit regression equation is:

$$Buyback_{i,t} = \beta_0 + \beta_1 Size_{i,t-1} + \beta_2 \Pr ofitability_{i,t-1} + \beta_3 Cash_{i,t-1} + \beta_4 Pay_{i,t-1} + \beta_5 IndLever_{i,t-1}$$
$$+\beta_6 Takeover_{i,t-1} + \beta_7 MTB_{i,t-1} + \beta_8 Ab\,\mathrm{Re}t_{i,t-1} + \beta_9 MO_{i,t} + \beta_{10} Negative_{i,t} + \beta_{11} EPSfactor_{i,t} + \mu_{i,t}$$

The probit regression equation is:

$$Buy_{i,t} = \gamma_0 + \gamma_1 Size_{i,t-1} + \gamma_2 \Pr ofitability_{i,t-1} + \gamma_3 Cash_{i,t-1} + \gamma_4 Pay_{i,t-1} + \gamma_5 IndLever_{i,t-1}$$
$$+\gamma_6 Takeover_{i,t-1} + \gamma_7 MTB_{i,t-1} + \gamma_8 Ab\,\mathrm{Re}t_{i,t-1} + \gamma_9 MO_{i,t} + \gamma_{10} Negative_{i,t} + \gamma_{11} EPSfactor_{i,t} + \varphi_{i,t}$$

EPSfactor is one if the CEO's bonus is directly tied to earnings per share, and zero otherwise.

Panel A: Tobit regression of scaled net repurchase

	Net repurchase scaled by market value of equity	Net repurchase scaled by market value of equity	Net repurchase scaled by market value of equity	Net repurchase scaled by market value of equity
Column	(1)	(2)	(3)	(4)
Log of total assets	0.006***	0.007***	0.007***	0.007***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Profitability	0.128***	0.125***	0.163***	0.177***
	(0.008)	(0.007)	(0.011)	(0.010)
Cash	0.038***	0.030***	0.038***	0.032***
	(0.004)	(0.004)	(0.005)	(0.004)
Payout ratio	-0.002	-0.003	-0.002	-0.003
	(0.002)	(0.002)	(0.003)	(0.002)
Industry-adjusted leverage	-0.007*	-0.012***	0.001	-0.003
	(0.004)	(0.004)	(0.005)	(0.004)
Takeover	0.002	0.001	0.001	0.001
	(0.005)	(0.005)	(0.005)	(0.005)
Market to book	-0.004***	-0.004***	-0.005***	-0.005***
	(<0.001)	(<0.001)	(0.001)	(<0.001)
Abnormal Return	-0.003***	-0.003***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Management options	0.217***	0.203***	0.249***	0.239***
	(0.027)	(0.023)	(0.029)	(0.026)
Earnings are negative	-0.012***	-0.013***	--	--
	(0.002)	(0.002)		
EPSfactor=1, if EPS is a factor; =0, otherwise	0.005***	0.005***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Intercept	-0.102***	-0.089***	-0.099***	-0.088***
	(0.015)	(0.011)	(0.016)	(0.011)
Number of observations	8,961	11,333	7,541	9,289
Chi-squared	1,354.03	1,749.36	1,073.18	1,318.35
Prob> Chi-squared	<0.001	<0.001	<0.001	<0.001

***, **, and *: significance at 1%, 5%, and 10% level, respectively.

Panel B: Probit regression of share buyback

	=1, if net repurchase is positive; =0, otherwise	=1, if net repurchase is positive; =0, otherwise	=1, if net repurchase is positive; =0, otherwise	=1, if net repurchase is positive; =0, otherwise
Column	(1)	(2)	(3)	(4)
Log of total assets	0.181***	0.178***	0.200***	0.203***
	(0.012)	(0.011)	(0.013)	(0.012)
Profitability	2.817***	2.699***	3.883***	4.097***
	(0.255)	(0.210)	(0.349)	(0.308)
Cash	0.436***	0.287***	0.355**	0.261**
	(0.118)	(0.099)	(0.135)	(0.117)
Payout ratio	0.019	-0.028	0.032	-0.012
	(0.062)	(0.056)	(0.069)	(0.063)
Industry-adjusted leverage	-0.748***	-0.808***	-0.608***	-0.668***
	(0.113)	(0.098)	(0.127)	(0.113)
Takeover	-0.062	-0.054	-0.143	-0.080
	(0.133)	(0.117)	(0.154)	(0.141)
Market to book	-0.052***	-0.056***	-0.065***	-0.075***
	(0.012)	(0.010)	(0.014)	(0.012)
Abnormal Return	-0.066**	-0.066***	-0.075**	-0.073**
	(0.027)	(0.023)	(0.032)	(0.027)
Management options	3.202***	2.698***	4.275***	3.745***
	(0.700)	(0.600)	(0.782)	(0.676)
Earnings are negative	-0.232***	-0.227***	--	--
	(0.044)	(0.038)		
EPSfactor=1, if EPS is a factor in bonus decisions; =0, otherwise	0.132***	0.144***	0.111***	0.125***
	(0.030)	(0.026)	(0.033)	(0.029)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Intercept	-2.571***	-2.099***	-2.568***	-2.122***
	(0.320)	(0.246)	(0.345)	(0.270)
Number of observations	8,961	11,333	7,541	9,289
Chi-squared	911.29	1,150.88	766.51	963.45
Prob> Chi-squared	<0.001	<0.001	<0.001	<0.001

***, **, and *: significance at 1%, 5%, and 10% level, respectively.

Table 5: Comparison of EPS-linking versus non-EPS-linking firms

This table compares the characteristics of the two groups of firms: those with CEO bonus linking to EPS and those not. GIndex is obtained from IRRC Goverance data, as constructed by Gompers, Ishii, and Metrick (2003); Institutional holding is the ratio of shares owned by the institutions divided by the total number of shares outstanding (the source is the Thomson Financial Institutional Ownership database).

	EPS-factor firms Mean (Median)	Non-EPS-factor firms Mean (Median)	t-test: t-stat (p-value)	Kruskal-Wallis test: Chi-squared (p-value)
Total assets ($mil.)	4,864	3,383	3.71	207.80
	(1,168)	(735)	(0.0002)	(<0.0001)
	n=6,125	n=3,711		
Cash	0.12	0.16	10.41	51.63
	(0.06)	(0.08)	(<0.0001)	(<0.0001)
	n=6,093	n=3,684		
Profitability	0.05	0.03	7.76	119.89
	(0.06)	(0.05)	(<0.0001)	(<0.0001)
	n=6,092	n=3,685		
Payout ratio	0.19	0.16	5.17	80.94
	(0.06)	(0.00)	(<0.0001)	(<0.0001)
	n=5,784	n=3,446		
Leverage	0.22	0.21	2.49	14.00
	(0.21)	(0.19)	(0.01)	(0.0002)
	n=6,067	n=3,681		
Industry-adjusted leverage	0.06	0.04	3.62	12.32
	(0.04)	(0.02)	(0.0003)	(0.0004)
	n=6,067	n=3,681		
Takeover	0.01	0.01	1.16	1.28
	(0.00)	(0.00)	(0.24)	(0.26)
	n=6,125	n=3,711		
Market to book	1.92	1.87	1.08	97.18
	(1.45)	(1.27)	(0.28)	(<0.0001)
	n=6,067	n=3,681		
Abnormal Return	6.83%	10.55%	0.98	21.47
	(0.45%)	(-4.68%)	(0.33)	(<0.0001)
	n=5,955	n=3,609		
Management options	0.029	0.030	1.91	0.00
	(0.022)	(0.022)	(0.06)	(0.98)
	n=5,963	n=3,582		
GIndex	9.45	9.02	5.50	30.53
	(9.00)	(9.00)	(<0.0001)	(<0.0001)
	n=3,475	n=1,722		
Institutional holding	44.96%	51.63%	6.40	28.63
	(55.85%)	(60.84%)	(<0.0001)	(<0.0001)
	n=3,475	n=1,722		

Table 6: The endogeneity of EPS linking and share buyback

This table reports the coefficients and standard errors from the two-step analysis of EPS linking and share buyback, and the results from the propensity score matching approach. Observations with negative earnings are excluded. Panel A reports the results from the probit analysis of whether the CEO's bonus is tied to EPS in the first step. Panel B reports the estimated coefficients and standard errors obtained from the tobit (Column 1 and 2) and probit (Column 3 and 4) regressions of share repurchasing in the second step. In Column 1 and 3, the propensity score derived from the first step replaces the dummy of EPS factor in the second step. In Column 2 and 4, the propensity score derived from the first step is used as the instrument variable for the dummy of EPS factor in the second step. Panel C reports the estimated coefficients and standard errors obtained from the tobit (Column 1) and probit (Column 2) regressions of share repurchasing on the propensity score matched-pair sample.

Panel A: The probit analysis of whether the CEO's bonus is tied to EPS in the first step

	=1, if CEO's bonus is tied to EPS; =0 if CEO's bonus is not tied to EPS
GIndex	0.028***
	(0.009)
Institutional holding	-0.140**
	(0.064)
Log of total assets	0.133***
	(0.020)
Cash	-1.159***
	(0.191)
Profitability	1.171***
	(0.384)
Payout ratio	0.187**
	(0.095)
Industry-adjusted leverage	-0.015
	(0.180)
Takeover	0.147
	(0.226)
Market-to-book	0.045**
	(0.019)
Abnormal Return	-0.036
	(0.023)
Management options	2.512**
	(1.191)
Year fixed effects	Yes
Industry fixed effects	Yes
Intercept	4.798***
	(0.539)
Number of observations	4,150
Chi-squared	589.23
Prob> Chi-squared	<0.001

*** and **: significance at 1% and 5% level, respectively.

Panel B: Tobit and probit analysis of share repurchasing in the second-step

	Net repurchase scaled by market value of equity	Net repurchase scaled by market value of equity	=1, if net repurchase is positive; =0, otherwise	=1, if net repurchase is positive; =0, otherwise
Column	(1)	(2)	(3)	(4)
Log of total assets	-0.004***	-0.007*	0.005	-0.019
	(0.001)	(0.004)	(0.033)	(0.025)
Cash	0.129***	0.161***	1.983***	1.035***
	(0.012)	(0.040)	(0.326)	(0.154)
Profitability	0.078***	0.053	2.764***	0.912
	(0.025)	(0.052)	(0.622)	(0.605)
Payout ratio	-0.026***	-0.032***	-0.424***	-0.213**
	(0.004)	(0.011)	(0.101)	(0.072)
Industry-adjusted	0.020***	0.022	-0.368**	-0.134
leverage	(0.007)	(0.017)	(0.171)	(0.143)
Takeover	-0.008	-0.013	-0.287	-0.147
	(0.009)	(0.021)	(0.208)	(0.164)
Market to book	-0.007***	-0.008***	-0.090***	-0.046***
	(0.001)	(0.002)	(0.022)	(0.015)
Abnormal Return	0.001	0.001	0.009	0.009
	(0.001)	(0.002)	(0.026)	(0.012)
Management options	0.123***	0.080	1.758	0.372
	(0.047)	(0.129)	(1.244)	(1.048)
Propensity score	0.225***	--	4.191***	--
	(0.023)		(0.632)	
EPS factor (instrumented by the propensity score)	--	0.297***	--	2.229***
		(0.083)		(0.084)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Intercept	-0.200***	-0.247***	-4.578***	-2.189***
	(0.026)	(0.077)	(0.663)	(0.287)
Number of observations	4,150	4,150	4,150	4,150
Chi-squared	9.72	100.91	460.51	5,809.30
Prob> Chi-squared	<0.001	<0.001	<0.001	<0.001

***, **, and *: significance at 1%, 5%, and 10% level, respectively.

Panel C: Tobit and probit analysis of share repurchasing on the propensity score matched-pair sample

	Net repurchase scaled by market value of equity	=1, if net repurchase is positive; =0, otherwise
Column	(1)	(2)
Log of total assets	0.006***	0.226***
	(0.001)	(0.018)
Profitability	0.187***	5.489***
	(0.021)	(0.581)
Cash	0.043***	0.590***
	(0.007)	(0.181)
Payout ratio	-0.005*	-0.001
	(0.003)	(0.081)
Industry-adjusted leverage	0.025***	-0.095
	(0.006)	(0.150)
Takeover	0.018**	0.050
	(0.008)	(0.186)
Market to book	-0.005***	-0.094***
	(0.001)	(0.016)
Abnormal Return	-0.001	0.004
	(0.001)	(0.024)
Management options	0.312***	6.691***
	(0.036)	(1.019)
EPSfactor=1, if EPS is a factor in bonus decisions; =0, otherwise	0.007***	0.164***
	(0.001)	(0.036)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Intercept	-0.070***	-2.498***
	(0.021)	(0.539)
Number of observations	5,586	5,586
Number of EPS-linking observations	2,793	2,793
Chi-squared	13.52	615.84
Prob> Chi-squared	<0.001	<0.001

***, **, and *: significance at 1%, 5%, and 10% level, respectively.

Table 7: OLS regression of CEO bonus and probit analysis of bonus awarding

Panel A presents the estimated coefficients and standard errors obtained from the regression of CEO bonus according to the following model:

$$CEOBonus_{i,t} = \lambda_0 + \lambda_1 Size_{i,t} + \lambda_2 Ret_{i,t} + \lambda_3 Buyback_{i,t} + \lambda_4 EPSfactor_{i,t}$$
$$+\lambda_5 EPSfactor_{i,t} * Buyback_{i,t} + \delta_{i,t}$$

Column (1)-(3) in Panel A examines the natural log of bonus, while Column (4)-(6) in Panel A examines the ratio of bonus to the sum of bonus and salary. Panel B presents the probit analysis of whether a CEO is awarded a bonus in a year.

$$Bonus_{i,t} = \eta_0 + \eta_1 Size_{i,t} + \eta_2 Ret_{i,t} + \eta_3 Buyback_{i,t} + \eta_4 EPSfactor_{i,t}$$
$$+\eta_5 EPSfactor_{i,t} * Buyback_{i,t} + \phi_{i,t}$$

The numbers in the parentheses are the standard errors. The standard errors are clustered at the firm level, and are also robust to heteroskadesticity.

Panel A: OLS regression of bonus

	Log of (1+bonus)	Log of (1+bonus)	Log of (1+bonus)	Bonus/ (bonus+salary)	Bonus/ (bonus+salary)	Bonus/ (bonus+salary)
Column	(1)	(2)	(3)	(4)	(5)	(6)
Log of total assets	0.523***	0.500***	0.532***	0.047***	0.044***	0.048***
	(0.025)	(0.027)	(0.025)	(0.002)	(0.002)	(0.002)
One-year return to shareholders	1.263***	1.254***	1.243***	0.126***	0.125***	0.124***
	(0.052)	(0.052)	(0.052)	(0.005)	(0.005)	(0.005)
Net repurchase is positive	0.121	--	--	0.014*	--	--
	(0.101)			(0.007)		
Log of (1+net repurchase)	--	0.001	--	--	0.002	--
		(0.029)			(0.002)	
Repurchase scaled by market value of equity	--	--	-1.629	--	--	-0.073
			(1.821)			(0.130)
EPSfactor =1, if EPS is a factor; =0, otherwise.	0.158*	0.152*	0.204**	0.012*	0.010*	0.015***
	(0.092)	(0.085)	(0.080)	(0.006)	(0.006)	(0.005)
EPSfactor*buyback measure	0.241**	0.090***	5.757***	0.017*	0.007***	0.436***
	(0.120)	(0.033)	(2.127)	(0.009)	(0.002)	(0.159)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	-1.233**	-1.052*	-1.289**	-0.172***	-0.150***	-0.177***
	(0.576)	(0.581)	(0.583)	(0.044)	(0.044)	(0.044)
Number of observations	9,604	9,604	9,604	9,552	9,552	9,552
R-squared	0.32	0.31	0.31	0.31	0.31	0.31
Test if $\lambda_3 + \lambda_5 = 0$: F-stat (p-value)	22.55 (<0.001)	25.38 (<0.001)	12.72 (<0.001)	30.56 (<0.001)	42.41 (<0.001)	14.53 (<0.001)

***, **, and *: significance at 1%, 5%, and 10% level, respectively.

Panel B: Probit analysis of being awarded a bonus

	=1, if bonus>0; =0, otherwise	=1, if bonus>0; =0, otherwise	=1, if bonus>0; =0, otherwise
Column	(1)	(2)	(3)
Log of total assets	0.135***	0.128***	0.139***
	(0.015)	(0.016)	(0.015)
One-year return to shareholders	0.715***	0.711***	0.707***
	(0.049)	(0.049)	(0.049)
Net repurchase is positive	0.024	--	--
	(0.056)		
Log of (1+net repurchase)	--	-0.010	--
		(0.016)	
Repurchase scaled by market value of equity	--	--	-1.562
			(1.016)
EPSfactor =1, if EPS is a factor; =0, otherwise.	0.038	0.042	0.064
	(0.052)	(0.049)	(0.045)
EPSfactor*buyback measure	0.148**	0.048***	3.427***
	(0.071)	(0.018)	(1.229)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Intercept	-1.132***	-1.076***	-1.157***
	(0.304)	(0.306)	(0.305)
Number of observations	9,604	9,604	9,604
Wald chi-squared	1,362.26	1,360.09	1,353.82
Prob > chi-squared	<0.001	<0.001	<0.001
Pseudo R-squared	0.21	0.21	0.21
Test if $\eta_3 + \eta_5 = 0$: F-stat (p-value)	14.87 (<0.001)	13.81 (<0.001)	6.52 (0.01)

***, **, and *: significance at 1%, 5%, and 10% level, respectively.

Table 8: CEO bonus in firms with positive net repurchase and their propensity-score-matching non-repurchasing firms

In this table, we compare the bonus ($ thousand) of CEOs in firms with positive net repurchase with their propensity score matching non-repurchasing firms. We estimate a probit model of whether a firm has positive net repurchase, generate propensity scores based on the probit estimation, and then, for each firm with positive net repurchase, we choose a non-repurchasing matching firm in the same industry and fiscal year with the closest propensity score.

	Firms with positive net repurchase	Propensity-score-matching non-repurchasing firms	t-test: t-stat (p-value)	Kruskal-Wallis test: Chi-squared (p-value)
	Mean (median)	Mean (median)		
EPS is a factor in CEO bonus	599.48 (356.76)	518.21 (267.03)	4.13 (<0.0001)	15.65 (<0.0001)
	n=2,764	n=2,764		
EPS is not a factor in CEO bonus	350.60 (199.20)	363.74 (189.73)	0.61 (0.54)	0.08 (0.78)
	n=1,251	n=1,251		

Table 9: Share buyback and being close to threshold earnings per share

In this table, we examine the "As-if" EPS to measure what EPS would have been without the repurchase. For the repurchasing firms, we compute what EPS would have been without the repurchase, that is, the "As-if" EPS, as follows:

*As-if EPS 1=Earnings$_t$ / (Weighted average shares outstanding$_t$ +0.5*Shares bought$_t$)*

*As-if EPS 2= (Earnings$_t$ + 0.5*Cost$_t$) / (Weighted average shares outstanding$_t$ +0.5*Shares bought$_t$)*

If *As-if EPS 1* or *As-if EPS 2* is less than the threshold but within 15% of the threshold earnings per share, we say it is close to the threshold EPS. "n" is the number of observations.

Panel A: As-if EPS1

	Frequency of share repurchases	The amount of buyback ($ million)	Net repurchases scaled by market value of equity (%)
		Mean (Median)	Mean (Median)
As-If EPS 1 is close to the threshold earnings per share	75% (n=131)	355.76 (29.05) (n=131)	3.03 (1.75) (n=131)
As-If EPS 1 is not close to the threshold earnings per share	60% (n=272)	123.78 (2.98) (n=272)	2.37 (0.40) (n=272)
t test: t-stat (p-value)	2.88 (0.004)	2.87 (0.005)	1.63 (0.10)
Kruskal-Wallis test: Chi-square (p-value)	8.17 (0.004)	10.10 (0.002)	7.26 (0.007)

Panel B: As-if EPS2

	Frequency of share repurchases	The amount of buyback ($ million)	Net repurchases scaled by market value of equity (%)
		Mean (Median)	Mean (Median)
As-If EPS 2 is close to the threshold earnings per share	75% (n=130)	349.99 (28.88) (n=130)	3.01 (1.75) (n=130)
As-If EPS 2 is not close to the threshold earnings per share	60% (n=273)	127.38 (3.00) (n=273)	2.39 (0.41) (n=273)
t test: t-stat (p-value)	2.81 (0.005)	2.75 (0.007)	1.55 (0.12)
Kruskal-Wallis test: Chi-square (p-value)	7.76 (0.005)	9.16 (0.003)	6.67 (0.01)

Table 10: Multivariate analysis of share buyback and being close to threshold EPS

In this table, we present the estimated coefficients and standard errors obtained from the tobit regression of scaled net repurchase (Panel A) and probit regression of share buyback (Panel B). *"Close"* is one if the *As-if EPS* is less than but within 15% of the threshold earnings per share, and zero otherwise. Column (1) contains *As-if EPS 1*, and column (2) uses *As-if EPS 2*.

The tobit regression:

$$Buyback_{i,t} = \beta_0 + \beta_1 Size_{i,t-1} + \beta_2 \Pr ofitability_{i,t-1} + \beta_3 Cash_{i,t-1} + \beta_4 Pay_{i,t-1} + \beta_5 IndLever_{i,t-1}$$
$$+\beta_6 Takeover_{i,t-1} + \beta_7 MTB_{i,t-1} + \beta_8 Ab\,\mathrm{Re}t_{i,t-1} + \beta_9 MO_{i,t} + \beta_{10} Negative_{i,t} + \beta_{11} Close_{i,t} + \mu_{i,t}$$

The probit regression:

$$Buy_{i,t} = \gamma_0 + \gamma_1 Size_{i,t-1} + \gamma_2 \Pr ofitability_{i,t-1} + \gamma_3 Cash_{i,t-1} + \gamma_4 Pay_{i,t-1} + \gamma_5 IndLever_{i,t-1}$$
$$+\gamma_6 Takeover_{i,t-1} + \gamma_7 MTB_{i,t-1} + \gamma_8 Ab\,\mathrm{Re}t_{i,t-1} + \gamma_9 MO_{i,t} + \gamma_{10} Negative_{i,t} + \gamma_{11} Close_{i,t} + \varphi_{i,t}$$

The numbers in the parentheses are standard errors. We compute the standard errors in the regression by clustering by firm. These standard errors are also robust to heteroskedasticity.

Panel A: Tobit regression of scaled net repurchase

	Net repurchase scaled by market value of equity	Net repurchase scaled by market value of equity
Column	(1)	(2)
Log of total assets	0.007***	0.007***
	(0.002)	(0.002)
Profitability	0.331***	0.331***
	(0.062)	(0.062)
Cash	0.045	0.044
	(0.024)	(0.024)
Payout	-0.007	-0.007
	(0.006)	(0.006)
Industry-adjusted leverage	-0.007	-0.005
	(0.018)	(0.018)
Takeover	-0.021	-0.021
	(0.019)	(0.019)
Market to book	-0.008***	-0.008***
	(0.002)	(0.002)
Abnormal Return	-0.009	-0.009
	(0.007)	(0.007)
Management options	0.362***	0.361***
	(0.081)	(0.081)
Earnings are negative	-0.012	-0.013
	(0.012)	(0.012)
As-if EPS 1 is close to the threshold earnings per share	0.014***	--
	(0.005)	
As-if EPS 2 is close to the threshold earnings per share	--	0.013**
		(0.005)
Year fixed effects	Yes	Yes
Intercept	-0.087***	-0.087***
	(0.022)	(0.022)
Number of observations	385	385
Chi-squared	134.17	133.05
Prob> Chi-squared	<0.001	<0.001

***, and **: significance at 1% and 5% level, respectively.

Panel B: Probit regression of share buyback

	=1, if net repurchase>0; =0, otherwise	=1, if net repurchase>0; =0, otherwise
Column	(1)	(2)
Log of total assets	0.216***	0.216***
	(0.074)	(0.074)
Profitability	7.836***	7.849***
	(1.910)	(1.914)
Cash	0.272	0.277
	(0.790)	(0.788)
Payout	-0.029	-0.031
	(0.176)	(0.176)
Industry-adjusted leverage	-0.379	-0.326
	(0.629)	(0.623)
Takeover	-0.809	-0.814
	(0.452)	(0.450)
Market to book	-0.070	-0.071
	(0.075)	(0.075)
Abnormal Return	-0.338	-0.338
	(0.210)	(0.208)
Management options	5.071	5.013
	(3.258)	(3.261)
Earnings are negative	-0.154	-0.165
	(0.359)	(0.360)
As-if EPS 1 is close to the threshold earnings per share	0.478***	--
	(0.172)	
As-if EPS 2 is close to the threshold earnings per share	--	0.459***
		(0.178)
Year fixed effects	Yes	Yes
Intercept	-2.328***	-2.316***
	(0.643)	(0.645)
Number of observations	385	385
Chi-squared	93.87	93.27
Prob> Chi-squared	<0.001	<0.001

***, **: significance at 1% and 5% level, respectively.

Table 11: Three-year post-buyback abnormal returns

We keep the first repurchase of a firm only, i.e., we drop its subsequent repurchases from the sample. We follow the repurchasing firms during the three years after the end of the fiscal year in which they conduct the repurchase. For each repurchasing firm, we also find a matching non-repurchasing firm in the same industry with the closest firm size (measured by total assets). Using the calendar-time portfolio approach, we perform the following four-factor regression of monthly returns.

$$R_{buy,t} - R_{f,t} = \alpha_0 + \alpha_1(R_{m,t} - R_{f,t}) + \alpha_2 SMB_t + \alpha_3 HML_t + \alpha_4 UMD_t + \varepsilon_{p,t}$$

$$R_{buy,t} - R_{match,t} = \gamma_0 + \gamma_1(R_{m,t} - R_{f,t}) + \gamma_2 SMB_t + \gamma_3 HML_t + \gamma_4 UMD_t + \eta_{p,t} \cdot$$

$R_{buy,t}$ is the value-weighted portfolio return of repurchasing firms in month t; $R_{match,t}$ is the value-weighted portfolio return of matching firms in month t. Panel A uses the sample of all repurchasing firms. Panel B uses the subset of repurchasing firms with CEO bonus tied to EPS, and Panel C the subset of repurchasing firms whose CEO bonus is not tied to EPS.

Panel A: All repurchasing firms

	Intercept	Excess market return	Size	Book-to-market	Momentum	n	R-squared
$R_{buy,t} - R_{f,t}$	0.0031* (0.0017)	1.12*** (0.05)	0.08 (0.06)	0.01 (0.06)	-0.085** (0.043)	186	0.85
$R_{buy,t} - R_{match,t}$	0.0042* (0.0022)	-0.14* (0.07)	-0.11 (0.07)	0.12 (0.10)	-0.16*** (0.06)	186	0.19

Panel B: Repurchasing firms with CEO bonus tied to EPS

	Intercept	Excess market return	Size	Book-to-market	Momentum	n	R-squared
$R_{buy,t} - R_{f,t}$	0.0007 (0.0024)	1.09*** (0.08)	0.12 (0.08)	0.04 (0.10)	-0.18*** (0.05)	185	0.76
$R_{buy,t} - R_{match,t}$	0.0018 (0.0027)	-0.08 (0.09)	-0.02 (0.09)	0.01 (0.11)	-0.21*** (0.07)	185	0.08

Panel C: Repurchasing firms whose CEO' bonus is not tied to EPS

	Intercept	Excess market return	Size	Book-to-market	Momentum	n	R-squared
$R_{buy,t} - R_{f,t}$	0.0049** (0.0021)	1.16*** (0.06)	0.12 (0.07)	0.06 (0.08)	0.02 (0.05)	182	0.79
$R_{buy,t} - R_{match,t}$	0.0060** (0.0030)	-0.15** (0.09)	-0.11 (0.10)	0.32*** (0.14)	-0.08 (0.10)	182	0.18

***, **, and *: significance at 1%, 5%, and 10% level, respectively.

Table 12: Quarterly buyback

This table reports the mean and median fraction of buyback in each quarter for repurchasing firms. We calculate the quarterly repurchases as the change in common treasury stock (COMPUSTAT Quarterly #98). If treasury stock is zero in the current and prior quarter, we measure repurchases as the difference between stock purchase (COMPUSTAT Quarterly #93) and stock issuance (COMPUSTAT Quarterly #84). We then compute the ratio of buyback in each quarter to the total amount in the whole fiscal year.

	1st quarter	2nd quarter	3rd quarter	4th quarter	Kruskal-Wallis test: Chi-squared (p-value)
EPS-linking firms	0.25 (0.17) n=2,973	0.21 (0.16) n=2,972	0.26 (0.19) n=2,983	0.28 (0.20) n=3,003	27.24 (<0.0001)
Non-EPS-linking firms	0.28 (0.11) n=1,453	0.20 (0.14) n=1,448	0.25 (0.16) n=1,458	0.27 (0.14) n=1,467	4.10 (0.25)

Figure 1: The time series of EPS-bonus-linking

This figure plots the fraction of observations in each of the four categories ("EPS is not a factor in CEO bonus", "EPS is a factor in CEO bonus", "There is no bonus component in CEO bonus", and "Cannot determine") from 1993 to 2007 (fiscal year). The information is collected from the proxy statements (DEF 14A) available on SEC website, starting from 1994 (calendar year).

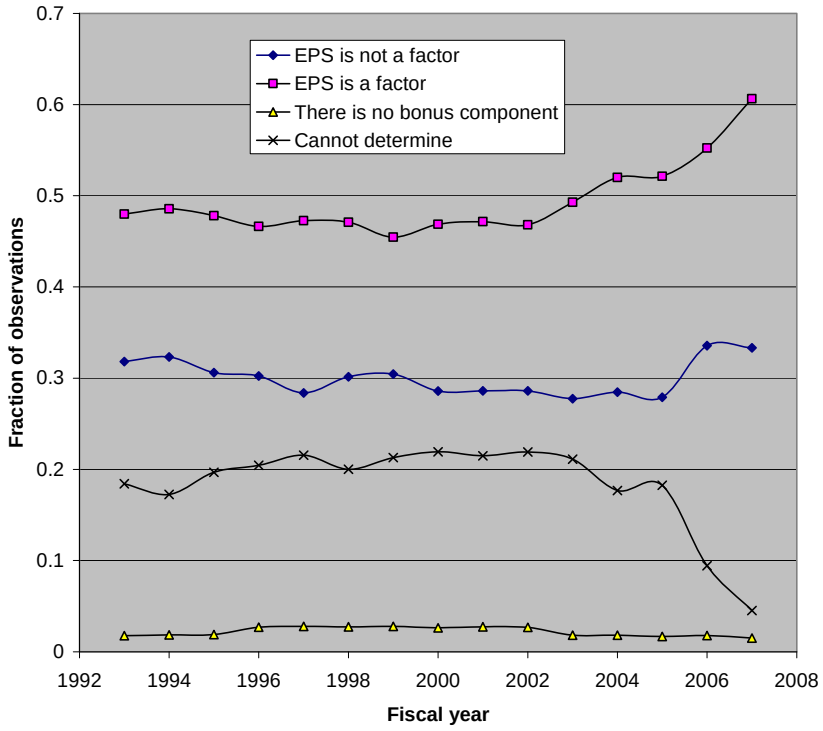

Figure 2: The average target bonus-to-salary ratio by year

This figure plots the average target bonus-to-salary ratio from 1993 to 2007 (fiscal year). The target bonus-to-salary ratio is specified by the compensation committee by the beginning of the fiscal year. The information is collected from the proxy statements (DEF 14A) available on SEC website.

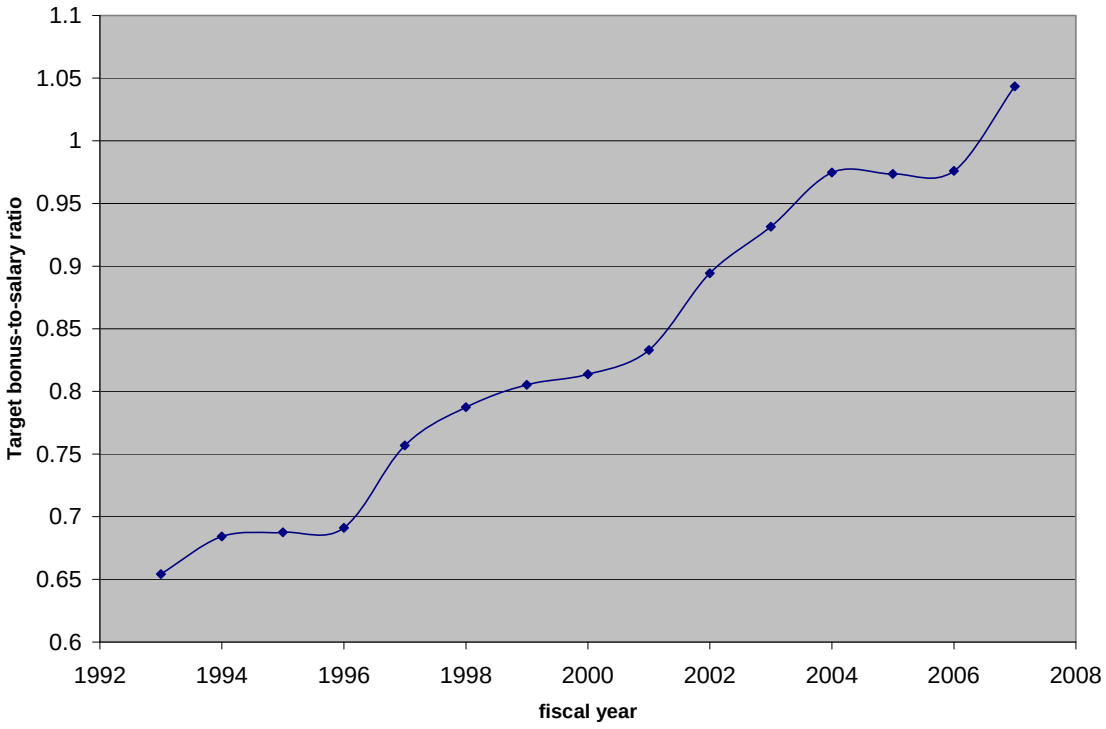

Figure 3: Total net repurchases ($ million) by year

This figure plots the dollar amount of total net repurchases by industrial firms from 1960 to 2007 (fiscal year). The sample includes all industrial firms (excluding financial and utilities firms) listed on COMPUSTAT.

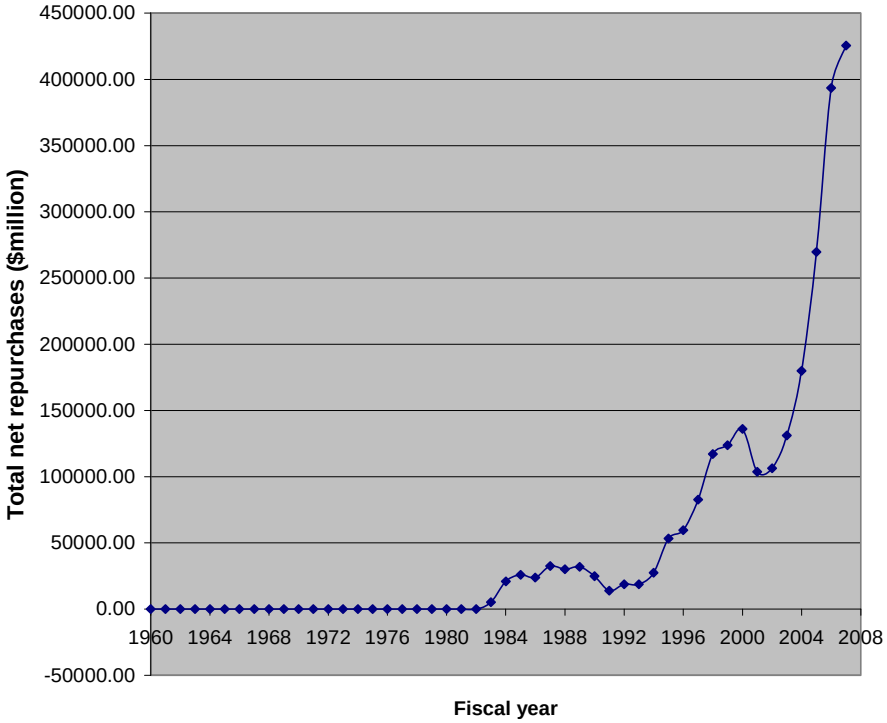

Figure 4: The percentage of firms with positive net repurchase by year

This figure plots the percentage of firms with positive net repurchase from 1993 to 2007 (fiscal year).