Option Exercises, Dilution, and Earnings Management: Evidence from a Regression Discontinuity*

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December 2018

*A previous draft of this paper was circulated under the title: "Does Dilution from Option Exercises Cause Share Repurchases?". We thank Heitor Almeida, Alice Bonaime, Felipe Cortes (discussant), Peter Haslag, Scott Weisbenner, Ryan Williams (discussant), Yuhai Xuan and seminar and conference participants at the University of Illinois at Urbana-Champaign, NFA Charlevoix, FMA San Diego, and UIC for many helpful comments and suggestions. Xing Gao is at the University of Illinois at Urbana-Champaign; Department of Economics; 1407 W Gregory Dr; Urbana, IL 61801; U.S.A.; Email: hgao12@illinois.edu. Mathias Kronlund is at the University of Illinois at Urbana-Champaign; Gies College of Business; 1206 South Sixth Street; Champaign, IL, 61820; U.S.A.; Email: kronlund@illinois.edu

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Abstract

Option exercises increase a firm's shares outstanding and dilute earnings per share (EPS), giving the firm an incentive to manage EPS, either by increasing earnings or through buybacks. We examine what firms do in response to plausibly exogenous option exercises using a fuzzy regression discontinuity framework, by focusing on close-to-the-money options near their expiration. If the firm's share price is just above an option's strike price on the expiration date, the option is significantly more likely to be exercised compared to if the share price ends up just below the strike. We show that these "just-in-the-money" exercises put pressure on EPS, and firms respond by engaging in both real- and accruals-based earnings management. These effects are stronger when the exercise is larger and more dilutive, and hold only when earnings are positive. However, firms do not engage in more repurchases, suggesting that dilution from options compensation are not a significant driver of buybacks.

JEL category: 35

Keywords: option exercises, regression discontinuity, earnings management, share repurchases, EPS, dilution, executive compensation

1 Introduction

Equity-based compensation for corporate executives, in the form of restricted stock and stock options, has increased substantially over the last couple of decades. For example, in 2015, CEOs among S&P 1500 firms on average were awarded around $1 million in option awards (Black-Scholes value), and exercised previously granted options for a value of $3 million. The intended purpose of equity-based pay is to align the interests of managers and shareholders more closely. Researchers and practitioners have nevertheless recognized that equity-based pay can have unintended consequences, for example, by encouraging manipulation of stock prices or by distorting corporate decisions.

This paper investigates one such distortion, namely whether the increase in the firm's outstanding shares that results from options compensation can cause firms to manage their EPS. The basic argument is the following: When executives exercise options, those options turn into new shares, which causes the number of shares outstanding to expand. The increased share count mechanically causes per-share performance metrics (such as EPS) to contract because of the growth in the denominator.[1] Analysts and stock market investors pay careful attention to these per-share metrics, and missing an EPS target, even if only by a very narrow margin, can disappoint investors and result in negative stock market returns (Skinner and Sloan, 2002). Furthermore, executives themselves are often explicitly compensated in the form of bonuses that are tied to meeting or beating EPS targets, which gives these executives an added incentive to avoid any negative impacts to EPS. Firms may thus seek to counter the negative effect on EPS that result from option exercises.

Firms have two main ways of strategically managing EPS: 1) doing a buyback, which reduces the denominator, or 2) by increasing the earnings (the numerator) through earnings management. Several academic papers have argued that the former mechanism, anti-dilutive buybacks in response to options compensation, is an important driver of buybacks (Bens, Nagar, Skinner, and Wong, 2003; Kahle, 2002), and this view is also prevalent in

[1]The effect from exercises on EPS is bigger for "basic EPS" and relatively smaller for "diluted EPS", especially for options that are far in the money, because diluted EPS already accounts for the possibility of future exercises. We will focus on a set of options that are close-to-the-money and thus represent significant shocks to both "basic" and "diluted EPS".

the press, see e.g. (Coggan, 2015). If firms buy back the same number of shares as the number of options that were exercised, they can perfectly undo the dilution caused by the exercise and limit the adverse effect on EPS (Coggan, 2015).[2] Executives themselves have also claimed that this channel is important: In a survey of executives, two-thirds of CFOs cited options anti-dilution as a "very important" or "important" driver of repurchases (Brav, Graham, Harvey, and Michaely, 2005).

Even though earnings management around option exercises has not received as much attention, there are nevertheless good reasons to believe that real- and accruals-based earnings management could be at least as important as repurchases when it comes to managing EPS around options exercises. For example, in a survey of 400 executives, Graham, Harvey, and Rajgopal (2005) asked what executives would do if it looked like their company might come in below the desired EPS target. 80% of executives reported that they would "decrease discretionary spending (e.g., R&D, advertising, maintenance, etc.)", making it the most popular option, and 40% reported they would "book revenues now rather than next quarter" (*i.e.*, accruals management, making it the third-most popular option). By contrast, only 12% of executive reported they would repurchase shares if faced with this situation.

The primary goal of this paper is to employ a novel identification strategy to examine to what extent firms do share buybacks or engage in other forms of earnings management strategies to counter the EPS dilution from option exercises. What firms do in about dilution from options is important. Excessive share buybacks can have real consequences when the money spent on repurchases instead could have been used to invest in plants, R&D, or to hire more employees (Almeida, Fos, and Kronlund, 2016). Direct cuts to R&D and other discretionary spending could, in turn, result in worsened firm performance going forward (Bens, Nagar, and Wong, 2002, e.g.,).

While previous research has shown that dilution from options and repurchases indeed

[2]While most buybacks do increase EPS, they do not always do so. Specifically, a repurchase will increase EPS when the firm's earnings-to-price ratio is higher than the opportunity cost of funds (e.g., the after-tax interest earnings on cash holdings or the marginal cost of debt used to pay for the buyback). As an obvious example, a firm with negative earnings would only cause its EPS to become even more negative if doing a buyback to reduce the number of shares.

are strongly correlated (Bens et al., 2003; Kahle, 2002, e.g.,), it is naturally challenging to establish whether options have a *causal* impact on repurchases as implied by the "anti-dilution" hypothesis. The reason is that both the extent to which executives receive options, when and whether those options are dilutive or end up being exercised, as well as the extent of share buybacks are endogenous outcomes that depend on multiple industry-, firm-, and executive-level factors that are difficult to control for in a regression framework. Options can also put pressure on *diluted* EPS even before they are exercised, raising the question whether firms should manage "basic" or "diluted" EPS.[3] For outstanding options to have a significant impact on diluted EPS, that implies that the firm in the past has awarded many options and also that the firm's stock price has performed well since then, so that the options are now (far) in-the-money. A wide range of firm characteristics, including recent firm performance, growth opportunities, life cycle, and liquidity position can affect both a firm's use of options compensation and its payout policy. These kinds of factors could plausibly introduce a spurious correlation between exercises and repurchases, in which case their relationship may not be causal.[4]

Consider a firm that has experienced strong returns—that firm is more likely to experience exercises because its options are more likely to be in-the-money, but strong stock performance often goes hand-in-hand with high cash flows that the firm can use for buybacks. Similarly, younger firms are more likely to use stock options as part of their compensation packages because they are "cash-poor"; but these firms may also not want to commit to regular dividend payments but instead use repurchases to distribute any excess cash. Causal inference in this setting is challenging precisely because factors like a firm's life cycle and financial constraints can be hard to measure well and perfectly control for in a regression framework (see, for example, Erickson and Whited (2000). The direction of causality could even go the other way, from repurchases to options: for example,

[3]The effect of outstanding but yet-unexercised options on diluted EPS—based on the "treasury stock method"—is calculated by assuming that any cash the firm receives as the strike price in the exercise would be used to buy back shares. The resulting formula for the "impact" of each option is max{0, 1-X/P}, where X is the strike price and P is the firm's share price. The treasury stock method thus implies that, for example, if a firm has 1000 outstanding options with a strike price of $25 and a share price of $50, the number of shares that are added to current shares when calculating diluted EPS is 500 (1000*(1-25/50)). Conversely, outstanding options that are out-of-the-money or at-the-money do not affect diluted EPS.

[4]Larcker (2003) makes this argument in a concurrent comment on Bens et al. (2003).

Babenko (2009) show that buybacks increase employees' pay-performance sensitivity and cause employees to carry more risk, which in turn encourages employees to exercise their options.

To examine the causal effect of exercises on EPS management (share repurchases and earnings management), this paper employs a "fuzzy regression discontinuity" (fuzzy RD) framework. The idea behind the experiment we have in mind is the following: Imagine two firms, A and B, that both awarded their executives 100,000 options in 2006 that are set to expire in 2016; both firms' stock prices on the grant date were $25, and as is typical for executive options, the strike price for these options was the same as the stock price when they were granted (*i.e.*, "at-the-money"). Fast-forward to 2016 when these options are about to expire; now, suppose the stock prices of these firms have been fairly stagnant, and so their stock prices remain around $25. Firm A has nevertheless performed slightly better than firm B: Firm A has a stock price of $25.50, while firm B has a stock price of $24.50 on the day when the options are about to expire. Despite similar characteristics and almost-identical performance, the executives in firm A are more likely to exercise their options which would increase the number of shares outstanding, compared to firm B. This framework thus provides a quasi-exogenous shock to exercises, and according to the anti-dilution hypothesis, we might then expect firm A to buy back shares or engage in other forms of earnings management in response to these exercises to maintain its EPS, compared to firm B that experiences no dilution. One prominent example of this kind of situation involves Goldman Sachs CEO Lloyd Blankfein and Bank of America CEO Brian Moynihan, both of whom received around 200,000 options in late 2006 and early 2007. Goldman's stock price was almost perfectly flat over the 10-year period after Blankfein's options were granted, but narrowly rose above the strike price (by around 2%) by the time the options were about to expire, causing Blankfein to exercise his options, whereas Moynihan's options expired worthless.[5]

In our empirical framework, we first define the variable *price gap* as the difference on the option expiration date between the firm's share price and the option's strike price

[5]See the Wall Street Journal (Feb 16, 2017) at https://www.wsj.com/articles/bank-of-america-misses-a-big-options-payday-goldman-cashes-in-1487154601

(adjusted for splits and stock dividends since the grant), normalized by the adjusted strike price. In the example above, this was \$0.5/25=+2% for firm A and \$-0.50/25=-2% for firm B, respectively. At a price gap of zero, there is a discrete jump in the level of exercises, where executives with options to the right of the gap are more likely to exercise their options because they end up slightly in-the-money. We then limit the observations to only instances of price gaps that fall within a narrow price gap window of 20% around the strike price and examine how the discontinuity around the zero-price-gap relates to changes in firm outcomes (while controlling for any linear relation with the price gap).[6] The RD is "fuzzy" (Angrist and Lavy, 1999; Van der Klaauw, 2002), because a stock price above the strike price on the expiration date does not guarantee that the option is exercised and that no options are exercised below, but it nevertheless increases the *likelihood* that an option is exercised.

There are several reasons why the price gap does not produce a "sharp" discontinuity. First, options can be forfeited or re-structured throughout an option's life (usually 10 years), for example, if an executive leaves the firm or if there is a reorganization such as an acquisition or a merger. Second, even though most options have vesting requirements that require executives to continue holding an option for several years, an option can be exercised early anytime after the vesting period, and many executives do exercise early (Klein and Maug, 2011). Theoretically, a risk-neutral executive should never exercise a call option early except possibly before a dividend payment (Merton, 1973), and even risk-averse executives should not exercise early unless the option is far in-the-money (Carpenter, Stanton, and Wallace, 2010). In our setting, early exercises are less common, precisely because the options that we focus on are by construction out of the money or only barely in the money for most of their lives. Third, executives sometimes exercise options even if they are slightly out-of-the-money, *i.e.* when the price gap is negative (Fos and Jiang, 2015). The fact that we do not have a sharp discontinuity for many of these reasons is not a threat to the validity of the identification strategy, but it nevertheless affects how we should interpret the resulting regression coefficients. Specifically, the results from the fuzzy RD are a local average treatment effect (LATE) which captures the

[6] Our results are robust to alternative definitions of the bandwidth around the threshold.

effect among firms where the executive's decision to exercise or not depends on whether the price is above or below the strike price on expiration ("compliers"). We nevertheless do require that at least some executives hold their options until close to the expiration for there to be a statistically strong "first stage", so that the likelihood that an option is exercised indeed increases discontinuously around the zero-price-gap threshold.

Our data starts with all executive options in the Execucomp database that have been granted after 1992 and that also expired by the end of 2016. Every firm has several executives, all of whom in turn can hold several options, but our primary outcome variables are defined at the firm-quarter level, which implies that we need to carefully aggregate our data across options to get a firm-quarter level measure of the *price gap*. To do so, if a firm has multiple options that have the same expiration day and strike price, we treat them as one but sum across the number of shares that underlie the options. We further drop options that have been fully exercised before the quarter when the option expires, or if the still-unexercised size is smaller than 0.1% of shares outstanding. If a firm has multiple options that expire in the same quarter, but with different strike prices or expiration dates, we further select only the largest option. This process results in a total of 5,183 options that are unique to a firm-quarter. When we limit the sample to only those options that fall within the 20% price gap range, we end up with 899 options, which makes up the core of our sample. These options on average represent around 0.4% of shares outstanding. This magnitude is similar to the level of quarterly repurchases—which means that if these options were to be offset by repurchases that would in turn represent a sizeable shock to buyback activity.

In our empirical analysis, we start by showing that the first stage—*i.e.*, the relation between the zero-price-gap threshold and exercises—is strong. When we plot exercises on the price gap on the expiration date (Figure 1), we see that there is a discontinuity in the level of exercises right around the zero-threshold. There are very few exercises to the left of the threshold and many exercises to the right of the threshold.[7] Importantly, the

[7]We also observe that there are some exercises also in the price gap region between -2% and 0. This is consistent with the "out-of-the-money" exercises studied by Fos and Jiang (2015) and Jensen and Pedersen (2016). Another reason for observing exercises with a negative price gap is that these exercises could have been done a few days or hours before the close on the expiration date when the price gap might have still been positive,

strength of the first stage is stronger when the underlying option is large. We further show that the higher level of exercises results in an increase in the number of shares outstanding and a mechanical decrease in EPS due to the increase in the denominator.

If firms seek to counter the dilutive effect of these plausibly exogenous option exercises, we should then observe more repurchases and/or more earnings management just to the right of the zero-price-gap threshold compared to the left. On the other hand, it is also possible that firms do not respond to these exercises—for example, if managers count on investors and analysts realizing that any negative effect on EPS was purely "mechanical"—in which case we would not observe any jump in repurchases or earnings management around the threshold. Crucially, the positive price gap indicator is plausibly uncorrelated with the many *other* reasons firms may have to engage in earnings management or share buybacks—which is one of the main advantages of this empirical strategy.[8]

Contrary to a positive relation between option exercises and repurchases, we show that firms *do not* engage in increased share buybacks in response to these quasi-exogenous exercises. Firms on either side of the zero-price-gap threshold have remarkably similar repurchase patterns, both repurchasing around 0.6% of total assets. This is true even for the largest options, which represent the greatest shock to shares outstanding, and also among firms that explicitly compensate their managers based on EPS and may have the strongest incentive to respond. We also see no delayed response over the following quarter or year, suggesting that the firms that experience exercises do not buy back the newly issued shares even with a delay. In sum, these results suggest that share dilution from exercises is not a significant causal driver of share repurchases. Firms thus appear willing to tolerate the resulting share expansion and not significantly alter buyback plans in response.

but that the stock price subsequently drifted down to end up with a negative price gap. Such mismeasurement around the threshold has the potential to shrink our regression coefficients but is small enough that it does not affect the first stage significantly. However, as an added robustness test, we also estimate our results using a "Donut RD" strategy which throws out the observations in a region of 1% around the threshold; see, e.g., Almond and Doyle (2011); Cahuc, Carcillo, and Le Barbanchon (2014); Rau, Sarzosa, and Urzúa (2015) for other examples of Donut RD.

[8]For example, common reasons for buybacks include tax-efficiency (Desai and Jin, 2011), optimal leverage (Bagwell and Shoven, 1989), undervaluation (Ikenberry, Lakonishok, and Vermaelen, 1995), agency problems (Jensen, 1986), liquidity (Cook, Krigman, and Leach, 2003; Hillert, Maug, and Obernberger, 2016), or fending off takeovers (Bagwell, 1991; Billett and Xue, 2007).

Instead, we show that firms strongly engage in earnings management around these exercises. This happens both in the form of reduced R&D spending and higher accruals. These effects are stronger and only significant for firms that have positive earnings—firms with negative earnings naturally have no incentive to manage earnings around option exercises, since an expansion in shares makes their EPS better. We also show that especially accruals management is much stronger for firms where managers are explicitly compensated based on EPS. As a result of this earnings management, even though we observe a "mechanical" decrease in EPS that's driven by the denominator, the firms to the right of the threshold actually report *higher* increases in EPS because of higher growth in earnings (the numerator) compared to the firms on the left of the threshold. In sum, our results show that firms manage earnings when faced with a need to counter adverse shocks to EPS, but that repurchases are not affected.

We conduct several robustness tests to support the assumptions behind the quasi-experimental RD design. One possible threat to the identification could arise if firms manipulate the share price around exercises. Previous studies have shown that managers manage share prices around option *grants* (Baker, Collins, and Reitenga, 2003; Chauvin and Shenoy, 2001; Yermack, 1997, e.g.,), although there is less evidence of manipulation around option exercises (Carpenter and Remmers, 2001). Intuitively, executives do not have a particularly strong incentive to manage the share price precisely around the price gap threshold, because if the firm ends up just narrowly to the right of the price gap, then executives profit only based on the small difference between the strike price and the share price. In other words, the payoff from options as a function of the share price is continuous and exhibits no discrete jumps. Furthermore, to pose a threat to the identification strategy, it would have to be that managers to the right of the threshold manipulate differently from managers on the left, which is even harder to believe. Nevertheless, if managers do manipulate share prices so that they end up just-in-the-money, we would expect to see a mass of observations to the right of the threshold. We formally investigate this possibility but observe no "bunching" on either side of the threshold, but firms are smoothly distributed around the zero price gap threshold, which is thus consistent with "non-manipulation" of the assignment variable. Further, there are no systematic differences in other observable characteristics of the firms that end up on either side of the threshold. We also examine possible pre-trends and show that the firms that end up on the left and the right were also on similar trends before the expiration quarter. These tests thus support the notion that it is truly random which firms ended up on the right side of the threshold and which firms ended up on the left.

Our paper proceeds as follows. The next section describes the related literature. Section 3 describes our data and measurement. Section 4 presents summary statistics. Section 5 describes the results from OLS correlations, and Section 6 describes the fuzzy RD empirical strategy and the first-stage results on exercises. Section 7 presents results for firm responses to exercises. Section 8 discusses robustness tests, and Section 9 concludes the paper.

2 Literature

This paper relates to the literature that links executive compensation—and specifically exercises—to payout decisions. Weisbenner (2000), Kahle (2002), Bens et al. (2003) were among the first to study the relation between options compensation and payout policy. A more recent paper is by Ferri and Li (2016) who consider the relation between options compensation and payout policy using a diff-in-diff design. Ferri and Li (2016) specifically exploit a change to accounting standards (FAS123R) that mandated option grants to be expensed, which has been followed by firms awarding fewer options. They find that firms that were most "exposed" to FAS123R (the firms that had previously awarded the most options) did not change their dividends or buybacks after the law compared to other firms. Their question is slightly different from ours, as they focus on the effect of option *grants* on payout policy, and thus do not directly consider whether the channel between repurchases and options goes through dilution. Option grants can importantly affect payout policy even independent of dilution because dividend payments decrease the value of options, which can encourage firms to substitute repurchases for dividends—a "dividend-substitution hypothesis" (Fenn and Liang, 2001; Kahle, 2002; Lambert, Lanen, and Larcker, 1989; Liljeblom and Pasternack, 2006). Our empirical strategy instead explicitly tests the "anti-dilution hypothesis" under which repurchases are driven by dilution and exercises but not directly by grants; if options were granted but did not end up in-the-money, there would be no dilution. In contrast, under the "dividend-substitution" hypothesis, the grants themselves cause firms to substitute away from dividends, and that incentive is not related to whether the options end up being exercised or not.

This paper also relates to the literature that studies the link between repurchases and earnings management. Hribar, Jenkins, and Johnson (2006) and Almeida, Fos, and Kronlund (2016) document an abnormally high number of EPS-increasing repurchases among firms that otherwise would have small negative earnings surprises. Almeida et al. (2016) further show that this effect is particularly strong for firms that use EPS as an incentive measure for executives. Cheng, Harford, and Zhang (2015) also find that firms are more likely to do repurchases if executives' incentive plans are tied to earnings per share. In contrast to this literature, we find that in the setting of EPS dilution due to exercises, firms do not use repurchases as a tool to manage EPS. We find that firms instead are more likely to use earnings management when faced with adverse shocks to EPS from exercises, which is consistent. Bergstresser and Philippon (2006) also show a correlation between option exercises and high accruals, although their story behind this association is one of opportunistic (*i.e.*, endogenous) exercises in times when accruals are high, and not of earnings management as a response to dilution. In contrast to Bergstresser and Philippon (2006), we thus show that there is a causal link that also goes from (exogenous) exercises to earnings management.

Other papers have studied the relation between options and other corporate policies such as investment. Chava and Purnanandam (2010) find that executives with risk-increasing incentives adopt riskier corporate policies, such as higher leverage, lower cash holdings, and shorter debt maturities. Babenko, Lemmon, and Tserlukevich (2011) show that an increase in cash flows to the firm from exercises can increase real investment, especially for firms with high external financing costs. The empirical setting that Babenko et al. (2011) employ is most similar to ours as they proxy for the level of exercises using the ratio of the end-of-year stock price divided by average strike price for outstanding options (across all employees in a firm). They show that as employee options "on average" are more in the money, we observe more exercises. The main difference in the empirical setup between Babenko et al. (2011) and this paper is that because Babenko et al. average across a lot of different options for all executive and non-executive employees (who may have received their options at different times with different strike prices, and which may not be exercisable), they do not observe any jumps in the likelihood of exercises as a function of the "price ratio" they use. Their identification instead principally relies on changes in the *slope* of exercise intensity over a wide domain of the ratio.

3 Data and Measurement

3.1 Measuring Options

We collect data on options that were awarded starting from 1992 and that expired before the end of 2016. Our data source for option grant data is Compustat's Execucomp database. Because the SEC changed the disclosure requirements and reporting format of option grants in 2006, we employ two different tables from Execucomp before and after the disclosure reform.[9] For options that expire from 2007 onwards, we use the "Plan-Based Awards" table, which lists both new options granted in a fiscal year as well as the previously-granted-and-still-outstanding options as of the fiscal year-end. Because options are listed in this table every year between the grant year until the option disappears, we limit the observations to options that are scheduled to expire during the upcoming fiscal year. Filtering the sample of options in this manner eliminates any duplicate observations from the same option being listed across multiple years, and also by construction eliminates any options that have been forfeited, restructured, or exercised early before the start of the last fiscal year of the option's life. For options that expire before 2007 and thus are not covered by the "Plan-Based Awards" table, we instead use the "Stock Option Grants Awards" table. Because most options have a 10-year life, this mostly includes options that were granted between 1992 and 1996. The "Stock Option Grants Awards" table lists all options as of the year when they are granted. Because we cannot directly filter the

[9] See the SEC's final rule on "executive compensation and related person disclosure" at: https://www.sec.gov/rules/final/2006/33-8732a.pdf

options from this table based on whether these options are still "live" as of the last fiscal year before the option expires, we expect the first stage for this subset of options to be slightly weaker compared to the observations from the "Plan-Based Awards" table.

For each option, we get data on the number of underlying shares, the grant date, expiration date, and strike price. Our identification strategy compares firms with options that end up narrowly in-the-money and thus are more likely to be exercised versus firms with options that expire out-of-the-money. To measure whether an option is in-the-money or out-of-the-money on the expiration date, we define the *price gap* as the stock price on the expiration day minus the strike price, where we adjust the strike price for stock splits and stock dividends, with the difference normalized by the adjusted strike price:

$$\text{Price gap,i} = \frac{\text{Stock price on expiration date,i - Adjusted Strike Price,i}}{\text{Adjusted Strike Price,i}}$$

We further create a price gap indicator, which takes on a value of 1 if the price gap is positive, and 0, otherwise. If the price gap is positive, then the option is in-the-money on the expiration date and vice versa.

Our main outcome variables are defined at the firm-quarter level, which requires aggregation of the options data to summarize the effect of these options at the firm-quarter level. To do so, we combine all options (sum across the number of underlying shares) that belong to the same firm and have the same expiration date and strike price, and thus treat them as one. We exclude observations that belong to firm-quarters with expiring options that include both positive and negative price gaps, as these cannot be cleanly assigned to either side. This situation is possible if a firm has several options with different expiration dates or different strike prices where some end up in-the-money and others out-of-the-money. Lastly, if a firm has multiple options that expire in the same quarter (with different prices/dates but where all are on the same side of moneyness), we choose the largest option for determining the price gap measure at the firm-quarter level.

We collect data on option exercises from "Table 2" of the Thomson Reuters Insider Filing database. To ensure that these exercises relate to executive incentive options, we first limit this data to filings that are reported on Form 4 ("change in an insider's ownership position") with the transaction code "M" (exercises of derivative securities). We further restrict the reported derivative "type" to be either options, employee stock option, non-qualified stock option, call option, or incentive stock option, and we drop observations with a cleanse code that indicates invalid or missing data elements.[10]

To attain a more accurate representation of the expected size of the potential dilutive impact of an option as it gets close to expiration, we subtract from each option's reported size (from Execucomp) the number of options that have already been exercised up until the start of the last quarter of the option's life. To do so, we use the Thomson database and calculate the cumulative split-adjusted number of exercised options for each option award (where we match awards between the databases based on cusip, strike price, and the expiration date) up until the start of the quarter of expiration. We then define the option size as the reported size from Execucomp minus the cumulative number of options that have been already exercised. We use these exercises to drop any options that we know have been fully exercised, or if the still-unexercised size is less than 0.1% of share outstanding.

Because we require detailed option-level data on the strike price and expiration date of each option, we focus by necessity on only the options of only the "named executive officers", for whom options grants are detailed in SEC filings. Some of the previous research also has considered options belonging to non-executive employees, including Kahle (2002), Bens et al. (2003), and Babenko et al. (2011). The problem for our purposes of using all employee option data is that the only information available from firm filings are *average* strike prices and the total number of options, but not individual option-level data. If detailed option-level data on employee-level options were available, we would clearly like to include them as well. However this is not a significant threat to our study for at least two reasons: First, both executive options and employee options should have the same effect, since they equally cause dilution, so we have no reason to believe that a firm's reaction to employee exercises would result in a different effect from how firms react to

[10]We may inadvertently undercount actual exercises, both due to imperfect merging between Thomson and Execucomp and in applying the previously mentioned filters—this in turn can make the first stage appear relatively smaller in magnitude than the true level of exercises.

executive options. Second, even though non-executive options can make up a significant part of the total option pool, each option is often individually smaller, which means that these options may commonly not clear the 0.1% (as a fraction of shares outstanding) size hurdle we require for inclusion in our sample.

Finally, the previous literature has debated whether firms should be more worried about managing *basic* vs. *diluted* EPS, and thus whether they should manage EPS the moment an option becomes dilutive for diluted EPS (which can happen gradually as an outstanding option gets farther into the money) or when an option is exercised and causes dilution to basic EPS (Bens et al., 2003, see, e.g.). Our setting of examining close-to-the-money options is ideal for tackling the timing question of whether to manage dilution before the actual exercise or not, because the options that we study have almost no dilution before they are exercised, and become 100% (or 0%) dilutive after they are exercised (if the option ends up in the money) or expire. For example, an option that is 10% in the money would be 9% dilutive (1-X/P, according to the treasury stock method,) right before it is exercised, but jumps to being 100% dilutive the moment it is exercised. So even if a firm has bought back some shares before exercise, there is a big shock to the incentive to manage *both* basic and diluted EPS right at the time of exercise.

3.2 Measuring Repurchases, Earnings Management, and other Outcome Variables

We merge the firm-quarter level options data on the price gap with stock-level data from CRSP and firm-level data from the Compustat Quarterly file. We drop observations for firms with a stock price of less than one dollar or assets less than $1 million. The full merged sample consists of 5,183 observations that are unique to a firm-quarter. Of these, 899 represent firm-quarters where the absolute price gap is within 20%.

We measure repurchases using Compustat's variable "purchases of common and preferred stocks" minus any decrease in the par value of preferred stock, normalized by lagged total assets. This is different from the common way of measuring repurchases as a change in treasury shares, or as the difference between purchases and sales of stock (Fama and

French, 2001). The reason for why we measure repurchases this way is that we do not want to measure repurchases based on changes in treasury shares, because this measure can be mechanically confounded by exercises. For example, suppose an executive exercised an option and was awarded stock from the company's treasury shares, thus decreasing the treasury shares, and the firm subsequently repurchased the same number of shares, adding to the treasury stock. In this case, the firm has repurchased shares to undo the dilution from options perfectly, but we would not be able to detect that buyback based on the change in treasury shares which was zero. We do not subtract sales of shares from purchases because we want to isolate gross buyback activity. Banyi, Dyl, and Kahle (2005) compare reported repurchases from annual filings with measures available in Compustat, and conclude that the measure of repurchases that we use is the most accurate measure of actual repurchases, especially for firms using stock options, because it is not mechanically affected by equity issuance and the exercise of options.

To measure earnings management, we focus on two different kinds of earnings management: real and accruals-based. For real earnings management, we consider reductions in spending on R&D. R&D is a form of discretionary spending that is one of the most commonly used measures of real earnings management (Baber, Fairfield, and Haggard, 1991; Bushee, 1998; Dechow and Sloan, 1991; Roychowdhury, 2006, see, for example); for example, Baber et al. (1991) show that firms spend less on R&D when they are worried about meeting earnings targets. For accruals-based earnings management, we use three different measures that are based on total accruals as well as two different measures of discretionary accruals, following the Jones model (Dechow, Sloan, and Sweeney, 1995), respectively. As is common in the earnings management literature, we focus on absolute accruals (Bergstresser and Philippon, 2006; Cohen, Dey, and Lys, 2008; Cornett, Marcus, and Tehranian, 2008). For our first measure of discretionary accruals, we calculate residuals from regressing total accruals on the inverse of lagged assets, sales growth, and PP&E, all scaled by lagged assets (Bergstresser and Philippon, 2006, for a detailed example, see, e.g.,). For the second measure of discretionary accruals, we further adjust each these accruals by the average level of accruals across all firms in that quarter for a "time-adjusted" measure. Finally, we use data from IncentiveLab on whether an executive's compensation is explicitly tied to EPS. Definitions of these variables are found in the data appendix. All variables are winsorized at the 1% level.

4 Summary statistics

Table 1 presents summary statistics for options (panel A), exercises and payout variables (panel B), other outcome variables (panel C), and control variables (panel D). In Column 1, we present summary statistics for all observations, and in Columns 2 and 3, we present statistics for observations that have a positive versus negative price gap. In Columns 4–6, we further limit this to observations with a price gap between -20% and 20%; in other words, where the stock price on the expiration date falls within 20% of the strike price. Column 7 presents t-tests for the difference between Columns 5 and 6.

[Insert Table 1 about here]

Panel A in Table 1 reports summary statistics for option-level statistics such as the stock price on the expiration day, strike price, price gap, and option size. The average price gap is 0.969 on average (Column 1), which implies that a typical option ends up far in-the-money on expiration, although this distribution is right-skewed (the median price gap is 0.16). Out of the 5,183 options in our sample, 2,917 end up with a positive price gap while 2,266 options end up with a negative price gap. The average option size represents 0.48% of shares outstanding. When we limit the sample to the 899 options within the 20% range around the zero-price-gap, we observe that the average price gaps in the "positive" (Column 5) versus "negative" (Column 6) groups are 0.094 and -0.107 respectively, as we would expect if these options are distributed relatively evenly in the 20% range around the strike price. Overall, the options that end up with a negative or positive price gap look similar based on their strike price and size, though of course the options with positive price gaps on average have a slightly higher stock price on expiration.

Panel B reports statistics on exercises and payout policy in the quarter when an option expires (we refer to this quarter as "q_0"). Comparing exercises for firm-quarters that have positive (Column 2) versus negative (Column 3) price gaps, we find that there are significantly more exercises for firms that experience a positive price gap. The probability of having an option exercise is 43% for observations with a positive price gap, and 5% for negative price gaps. On average, firms tend to repurchase 0.62% of total assets in a quarter.[11] Comparing Columns 2 and 3, we observe that options that are in-the-money at expiration tend to belong to firms that have higher payouts than those with options with negative price gaps, which is natural because the firms with positive price gaps have clearly performed better, and thus motivates why doing looking at the regression discontinuity is important. In columns (5)–(6), where we limit the sample to only observations within the narrow price gap, payouts appear more balanced across the groups with a positive versus negative price gaps: Both groups of firms repurchase around 0.6–0.61% of total assets in the quarter of expiration. These simple statistics offer a first hint at our finding in Section 7 that firms do not respond to exercises by repurchasing shares: If these firms did perfect anti-dilution of the options, we would expect to the positive-price-gap firms to display significantly more buybacks. That said, while these simple averages compare all firms within the relatively narrow band, the regression discontinuity design enables us to more precisely determine whether there is a discrete jump precisely around the zero-price-gap threshold while controlling for any possible linear relation between the price gap and our outcome variables.

Panel C reports changes in other variables from q_{-1} (the quarter before expiration) to q_0, including changes in shares outstanding, measures of EPS, earnings management, shares issued, and cash balances. Comparing Columns 5 and 6 in Panel C, we observe that outstanding shares increase more (by around double) for firms with positive compared to negative price gaps, thus mechanically putting pressure on EPS, although the difference in

[11]For comparison to other research on buybacks, note that these figures are not the unconditional average in Compustat for the sample period, but rather the average conditional on having an expiring option in that quarter, as that is required for the price gap variable to be defined. In Table A1 in the Appendix, we also report similar statistics for all firms in Compustat, over the same period, regardless of whether they have outstanding options or not. Comparing these statistics to those of Panel B of Table 1, we observe that firms that use options on average tend to engage in more share repurchases compared to the average firm in Compustat, with the caveat that such comparisons are likely confounded by omitted variables.

this simple comparison of means is not statistically significant at conventional levels. Of particular note is our measure the "mechanical" denominator-driven EPS change, which is defined as lagged earnings divided by current shares outstanding minus lagged earnings divided by lagged shares outstanding; *i.e.*, this measure captures the change in EPS that would be expected if the numerator does not change, and we show that the firms on the positive side exhibit more downward denominator-driven pressure on EPS compared to their peers with slightly negative price gaps. However, Panel C also shows that the changes to reported *diluted* and *basic* EPS, despite the increase in the number of shares, are higher for the firms with a positive price gap, indicating that these firms also grow their earnings even more. While these are only suggestive summary statistics, we formally test these outcome variables within the fuzzy RD framework in Section 7.

We observe that firms with slightly positive price gaps have a larger increase in cash and shares issued than firms with slightly negative price gaps, consistent with cash inflows from exercises and new issues of shares in exchange, although these differences are not statistically significant in the simple comparison of means. It is important to note that employees who exercise options often have access to "cash-less exercises", where the employee does not have to put up money for the exercise price, but merely receives the difference between the strike price and share price, either in the form of cash or shares. However, even in these cases, the effect on the *firm* is the same—the firm receives money for the strike price and issues shares, but a broker or bank is acting as an intermediary by making a loan to the employee for the exercise price and immediately selling some of the shares received in exchange to pay back the loan (Heath, Huddart, and Lang, 1999).

Finally, Panel D of Table 1 presents statistics for several firm-level control variables, including market-to-book, cash flow, cash holdings, ROA, debt-to-assets, firm size, and an EPS incentive indicator. These variables are measured as of the end of the previous quarter (most variables), or as of the end of last fiscal year (in the case of the EPS indicator) before the expiration quarter. Importantly, when we narrow the window to a range of 20% around the zero-price-gap, the characteristics across the positive and negative groups appear balanced, and any differences are statistically insignificant. These findings support the identification assumption that the firms that narrowly end up on either side of the threshold are observationally equivalent when it comes to possible confounders to our empirical strategy.

5 Motivating correlational evidence

Before moving on to our regression discontinuity results, we also confirm the evidence in the current literature that there is a strong correlation between repurchases and options compensation, regardless of whether we measure options compensation using the amount of option grants, the amount of exercises, or the amount of unexercised exercisable options. Table 2 tests this hypothesis using OLS regressions over the period 1992–2017. We regress the log value of quarterly repurchases as the dependent variable on the log value of options grants, the log value of unexercised exercisable options, and the log value of exercises using firm-year level data from Compustat and Execucomp.

[Insert Table 2 about here]

The results in Panel of Table 2 show that repurchases are indeed strongly correlated with the value of option grants, option exercises, and exercisable options, both separately and when including all of these independent variables simultaneously. We further control for possible measurable confounders such as firm age and size, as well as industry × year fixed effects, with broadly similar results albeit smaller coefficients. These correlations also continue to hold after controlling for firm fixed effects which means that the same firm tends to do more repurchases during times when many options are granted, exercisable, or exercised, even though the economic coefficients here become yet smaller.

On the one hand, this evidence is consistent with a hypothesis of anti-dilution motivated repurchases. On the other hand, both repurchases and exercises could be driven by some unmeasured omitted factor such as financial constraints or performance, which makes a causal relationship challenging to ascertain. In addition to the measurable characteristics we control for, there are likely also many unobservable characteristics that differ across firms that affect both buybacks and options. The simple control variables that we employ in Table 2 reduce the estimated coefficients on exercised/exercisable options to almost a quarter of the original magnitude (from around 0.18 to 0.05). The omitted variable concern then is that it is plausible that a few still-omitted or hard-to-measure control variables, such as firm lifecycle or investment opportunities, could plausibly explain any remaining association between repurchases and options.

One way to ask whether the regression evidence of a relation between repurchases and option exercise is evidence of anti-dilutive buybacks is to test this in a sample where it should *not* work. Panel B of Table 2 therefore restricts the sample to firm-quarter observations with negative income. If anti-dilution from option exercises is a reason behind repurchases, firms should not be more likely to conduct repurchases in response to option exercises when their income is negative. However, if the positive correlation between repurchases and option awards is driven by other omitted variables, we may still observe a positive relationship between repurchases and option awards even during times with negative income. We find that in the sample of only quarters with negative income, the coefficients of option exercise and unexercised exercisable options are still significantly positive. This finding provides suggestive evidence that the relationship may not be causal or driven by earnings management concerns, thus further motivating the empirical strategy that we describe in the next section.

6 Empirical strategy and first stage results

To examine whether a causal relationship exists between option exercises and the various methods of managing EPS, we need an identification strategy that allows for plausibly exogenous variation in exercises that can isolate the effect of these exercises. We employ a fuzzy RD strategy (Angrist and Lavy, 1999; Van der Klaauw, 2002), by focusing on options that expire with a stock price close to the strike price. While firms that fall narrowly on either side of the zero-price-gap are ex-ante similar (as was shown in Panel D of Table 1), when a firm ends up on the positive side the option expires in-the-money and is therefore more likely be exercised, while on the negative side the options will more likely expire out-of-the-money.

To illustrate the discontinuous effect on exercises that is caused by the price gap, Figure 1 plots firm-quarter-level exercises of expiring options on bins of price gap on expiration (*i.e.*, the "first stage"). The x-axis represents normalized price gaps falling in the range of -0.2 to 0.2, which are grouped into ten bins with a bin size of 0.04. We see there is a discrete jump around the price gap of zero in the graph. In Panel A, the exercises are close to zero for slightly negative price gaps and around 0.15% of shares outstanding for positive price gaps. We nevertheless note that there are some "out-of-the-money" exercises, particularly in the price gap region between -4% and 0. This could be due to out-of-the-money exercises (Fos and Jiang, 2015), minor mismeasurement of the adjusted strike price, or because of exercises take place some days or hours before expiration with a subsequent price drift to below the strike price. Such mismeasurement around the threshold has the potential to shrink our regression coefficients, but is small enough that it does not affect the first stage significantly. However, as an added robustness test, we have also replicated our results using a "Donut RD" strategy which throws out the observations in a region of 1% around the threshold, with similar results.[12]

[Insert Figure 1 about here]

As described in Section 3.1, we make an effort to remove any options that have been exercised early (before the last quarter of its life) or that have disappeared (because of forfeiture, mergers, etc.). This method nevertheless does not ensure a perfect measure of the dilutive impact of any individual option as it nears expiration, because options can disappear for reasons that we are not able to capture, or because of exercises where we are not able to merge options perfectly between Thomson's "Table 2" and Execucomp. One way of summarizing how many options are still around is to compare actual exercises in a bin to the sum of options that we predict belong to that bin. Panel B shows that

[12] See, e.g., Almond and Doyle (2011); Cahuc et al. (2014); Rau et al. (2015) for other examples of Donut RD.

the fraction of exercised options to "predicted exercises" is around 30-40% for firms with positive price gaps, while this fraction is close to zero for negative gaps. If we could eliminate every option that is no longer around, we might expect the regression discontinuity to be "sharp", in the sense that every "predicted exercise" (instances where the price gap is positive) would correspond to an actual exercise.[13] Because we cannot eliminate every option that's no longer around, the RD is "fuzzy", implying that the price gap does not predict exercises perfectly but rather an increase in the likelihood of exercises. Having a non-strict RD does not invalidate the identification strategy, but rather means that the coefficients of the first stage and the "reduced-form" second stage results of the fuzzy RD are slightly smaller than they would be if we had perfectly measured data.

To formally test the first stage, we estimate the following regression for firm-quarters with options in the price gap range of [-0.2, 0.2]:

$$Exercise_{q0,i} = \alpha + \beta_1 \mathrm{I}[Pricegap_i{>}0] + \beta_2 Pricegap_i + \beta_3 Pricegap_i \times \mathrm{I}[Pricegap_i{>}0] + \epsilon_i,$$

The dependent variable is firm-quarter-level exercises of expiring options. Price gap is the size of the price gap on the expiration date, that is, the stock price on that date minus the strike price adjusted for stock split and stock dividends, normalized by the adjusted strike price. The main coefficient of interest, β_1, measures the extent to which there is a discontinuous jump in the level of exercises around the threshold while controlling for any linear relation with the price gap itself.

Table 3 reports results. In Columns 1–2, we use an indicator for whether there is an exercise, and in Columns 3–5, we use exercise size, which is the number of options exercised, normalized by shares outstanding. Column 1 shows that firms with slightly positive price gap options are 37.6% more likely to exercise compared to firms with slightly negative gaps. The coefficient of interest in Column 3 shows that firms with slightly

[13] This method is nevertheless more precise for options that expire after 2007, as we know the exact number of options that are still around as of the start of the fiscal year when the option expires. Panel A in Figure A.1 shows the fraction of actual exercises to total options per bin which tend to be in the 50-70% range to the right of the threshold.

positive price gaps experience additional exercises around 0.1% of shares outstanding—this is also consistent with the graphical results from Figure 1. We control for the level of the price gap itself and allow for different linear slopes on either side of the threshold in Columns 2 and 4. In Column 5, we further include an interaction of the positive price gap indicator with the option size, which shows that the predicted impact of having a positive price gap on the level of exercises is greater when the underlying option is large.

[Insert Table 3 about here]

In Table 4, we study the relation between our price-gap-based instrument and exercises across terciles based on the option size. Columns 1 and 2 include options in the smallest size tercile, Columns 3 and 4 include options belonging to the middle tercile, and Columns 5 and 6 include the largest options. We predict that the discontinuity around the zero-price-gap should predict more exercises when the underlying option is large. Indeed, the coefficients on the positive price gap indicator increase from 0.05% (Column 1) to 0.21% (Column 5) of shares outstanding as we increase the option size (or 0.02% to 0.22% when controlling for any linear relation). These results establish that there is a discrete jump in exercises right at the price gap threshold, and especially so for large options.

[Insert Table 4 about here]

To support the identification assumptions behind the regression discontinuity framework, we perform several supporting diagnostic tests. For the RD design to provide reliable estimates of a causal effect, the "assignment" of firms immediately around the threshold should ideally be "as good as random". This identification assumption could be violated, for example, if firms successfully manipulate their stock prices to make sure they fall narrowly on either side of the threshold. One way to test this empirically is to examine if there is bunching with an abnormally large mass of firms to one side of the threshold.

We test this in Figure 2 by plotting a histogram of observations around the zero-price-gap threshold. We observe no bunching of observations on either side of the threshold, and the distribution looks quite smooth. Panel A of Figure 2 plots the histogram of price gaps in the range of [-0.5,2], while Panel B zooms in closer to include only the price gap range [-0.2, 0.2]. The fact that the number of options is smooth around the price gap of zero is consistent with the assumption that firms are not actively manipulating their share prices precisely around the threshold. There are also conceptual reasons to believe that such manipulation is unlikely, or at least that such manipulation would be different between firms that end up narrowly on either side. Share prices are difficult to manipulate to the level of this precision right around the threshold as price move around by market forces outside the control of executives. Moreover, even if managers could push the share price to be only slightly above the strike price, there would be little incentive to do so because there is virtually no money to be made, as the executives receive only the difference between the stock price and strike price. In other words, while managers generally always seek to increase stock prices, their incentives to do so are unlikely to be any stronger-than-usual precisely around the zero-price-gap threshold.

[Insert Figure 2 about here]

Second, the identification strategy based on the regression discontinuity assumes that other firm characteristics do not exhibit jumps around the same threshold. As shown in Panel D of Table 1, the characteristics of firms that fall on either side of the threshold appear similar, as there are no significant differences in ex-ante characteristics (Columns 5–7).

Only considering options that have a stock price close to the strike price also has advantages beyond the identification benefits of allowing a fuzzy RD identification strategy. First, because these options are close to moneyness (and, in any case, they not far in-the-money), they are unlikely to be exercised early (see, e.g., Bettis, Bizjak, and Lemmon (2005) , Malmendier and Tate (2005), and Aboody, Hughes, Liu, and Su (2008) for discussions of incentives for early exercise). The basic reason why early exercise is unlikely in this setting is that the time value for an option is the greatest—and early exercise the most costly—when the stock price is close to the strike price. Early exercises could nevertheless introduce some noise in the first stage and thereby drive down the estimated coefficients in the first stage and reduced-form second stage. Another conceptual benefit of examining only options with a small price gap is that we do not need to make a distinction between firms' incentives to manage *basic* versus *diluted* EPS: Options that only have a small price gap are only so slightly in-the-money that the adjustment to the number of shares when calculating diluted EPS is minimal.[14]

7 Main results

This section describes "second stage" results based on the fuzzy RD framework. We first study the consequences of having a positive price gap on firms' shares outstanding and how changes to the denominator affect EPS. Next, we present results on repurchases. We then examine the effect of option exercises on other strategies that firms can use to mitigate the dilutive effects on EPS, including cutting real investment and accruals management. Throughout, we devote special attention to settings where we may expect a greater response to counter dilution: large options, when firms explicitly use EPS targets in determining compensation, and for firms with positive income.

7.1 Consequences for shares outstanding and mechanical EPS reduction

The results in the previous section showed a discontinuity in the level of exercises around the zero-price-gap threshold. In this section, we present evidence on how these exercises affect shares outstanding and how that, in turn, puts negative pressure on EPS.

Table 5 presents results on how firms on either side of the zero-price-gap threshold are affected in terms of changes to shares outstanding. We estimate regressions for firm-

[14]See, for example, Bens et al. (2003) for details on the how to calculate diluted EPS).

quarters with options within a 20% window around the zero-price-gap threshold that are of the form:

$$\Delta Shares_{q_{-1}\ to\ q_0,i} = \alpha + \beta_1 \mathrm{I}[Pricegap_i{>}0] + \beta_2 Pricegap_i + \beta_3 Pricegap_i \times \mathrm{I}[Pricegap_i{>}0] + \epsilon_i,$$

In Panel A, we use the percent change in shares outstanding, which is measured as the difference is shares between the end of the quarter of option expiration (q_0) and the previous quarter (q_{-1}), normalized by shares outstanding in q_{-1}. In Columns 1 and 2, we show results for the full sample, while Columns 3–4 focus on the top size tercile of options. Across the full sample of options, the number of shares does expand slightly but this difference is not statistically significant, but when we focus in on only the options in the top size tercile where the effect should be larger, the coefficients on the positive price gap indicator become larger and more significant. For these options, the number of shares expands by around 1.02% more for the firms that fall on the positive side of the threshold compared to the firms on the negative side, and this effect increases to 1.58% after controlling for any linear relation with the price gap. In Panel B, we measure the dependent variable as changes in log shares outstanding between q_0 and q_{-1}. The results are similar to those in Panel A and now also weakly significant even in the full sample of option awards.

[Insert Table 5 about here]

These results on shares outstanding are notably "net" of any buybacks. That is, the resulting expansion in shares shows that firms at least do not fully compensate for the expansion in shares from options exercises buy repurchasing more shares. In the next section, we will study if there is any measurable effect on buybacks at all to partly mitigate the share expansion.

We next study the extent of the dilutive effect that this expansion in shares has on earnings per share (EPS). To do so, we hold the EPS numerator (using the Compustat varibale "income before extraordinary items, available for common") constant at the lagged (q_{-1}) value, and calculate the resulting change in EPS that is "mechanically" driven by changes to the denominator:

$$\Delta Mechanical\ EPS_{q_{-1}\ to\ q_0} = \frac{Earnings_{q_{-1}}}{Shares_{q_0}} - \frac{Earnings_{q_{-1}}}{Shares_{q_{-1}}}$$

Table 6 reports results. In Panel A, we measure mechanical changes in EPS as income in q_{-1} divided by shares at the end of (q_0), minus income in q_{-1} divided by shares at the end of (q_{-1}). Given that shares increase more for the firms to the right of the threshold, we would expect that firms with positive income would see a denominator-driven reduction in EPS, while firms with negative income do not see any reduction. Thus, we split firms into positive and negative income earners (based on the income from the quarter before option expiration). Columns 1-4 include all awards, with positive income earners in Column 1 and 2, and negative income earners in Columns 3 and 4, whereas Columns 5 and 6 include only options in the top size tercile that belong to firms with positive income. In the full sample of positive income earners, EPS decreases "mechanically" by around 0.68 cents for the firms that fall on the positive side of the price-gap-threshold compared to the firms on the negative side. When income is negative, we do not see a statistically significant effect on EPS. As expected, the dilutive effect among the positive-income is larger when we focus on the top size tercile of options (columns 5–6), where EPS mechanically decreases by 1.56 cents for the positive-price-gap firms, thus providing firms with an even greater incentive to manage earnings. In Panel B, we further normalize these relative changes to EPS by the lagged stock price, with similar results. This pressure on EPS is notably significant compared to what a repurchase can achieve for a firm's EPS; for example, Hribar et al. (2006) show that fewer than 20% of all repurchases increase EPS by one cent or more.

[Insert Table 6 about here]

7.2 Do firms engage in anti-dilutive repurchases?

If firms do share buybacks to counter the dilutive effect of exercises, we should observe a similar discrete jump in repurchases around the zero price gap threshold. On the other hand, if the observed correlation between options exercises and repurchases is driven by potentially omitted variables or reverse causality, we should not observe a jump in repurchases at the zero-price-gap threshold.

Table 7 reports results on the effect of exercises on repurchases using the regression discontinuity framework. Similar to the previous section, we estimate the following regression for firm-quarters with options within a 20% window around the zero-price-gap threshold:

$$Rep_{j,q_0} = \alpha + \beta_1 \mathrm{I}[Pricegap_i > 0] + \beta_2 Pricegap_i + \beta_3 Pricegap_i \times \mathrm{I}[Pricegap_i > 0] + \epsilon_i,$$

The dependent variable is the level of repurchases for a firm j in the quarter q_0 when its option i expires. The main coefficient of interest, β_1, captures the extent to which there is a discrete change in the level of repurchases around the threshold. If firms do buybacks to counter the dilutive effect of exercises, we expect β_1 to be positive.

We report results using two different measures of the dependent variable: repurchases normalized by total assets (Panel A), and changes in normalized repurchases (Panel B). Columns 1 and 2 include all options in the 20% range, and Columns 3 and 4 includes only the largest options.

The results in Table 7 show that there is no jump in the intensity of repurchases around the zero price gap threshold. In Panel A, the coefficient of positive price gap indicator on normalized repurchases, β_1 is -0.05%, and not significant either economically or statistically. We obtain similar results in Panel B where we measure repurchases using quarterly changes. These results show that firms on average do not engage in anti-dilutive repurchases in response to share dilution caused by these plausibly exogenous option exercises.

[Insert Table 7 about here]

Figure 3 illustrates these results graphically. We plot average normalized repurchases on bins of price gaps in the [-0.2,0.2] range. The x-axis represents normalized price gaps falling in the range of -0.2 to 0.2, which are grouped into ten bins with a bin size of 0.04. If firms engage in anti-dilutive repurchases, we would expect a discrete jump to a higher level around the zero threshold. We do not see this. Instead, the distribution of repurchases appears quite flat overall, although with some idiosyncratic variation from bin to bin.

[Insert Figure 3 about here]

While we show that firms on average don't conduct repurchases to counter dilution due to exercises, it is nevertheless possible that many options may be too small to encourage firms to change their repurchase policy to counter them. To investigate whether the effect is different when firms are faced with exercises of the large options, we therefore redo our tests in a sample that is limited to options in the top size tercile (Columns 3 and 4). The coefficients on the positive price gap indicator are still insignificant (and the point estimate is even negative)—indicating that firms do not respond. For example, the coefficient is -0.044% on the level of repurchases (Panel A), and -0.256% on changes in repurchases (Panel B).

Figure 4 plots these results for the subset of large options graphically. We plot the firm-quarter level of exercises of expiring options (Panel A) and the level of repurchases (Panel B) on bins of price gaps for these large options. Exercises see a sharp increase when price gaps move from slightly negative to slightly positive. In contrast, the distribution of repurchases is flat over the range of price gaps without any discontinuous jump in repurchases around the zero price gap.

[Insert Figure 4 about here]

Further, only firms with positive income theoretically have any incentive to counter EPS dilution. By contrast, if a firm's income is negative, having more shares from option exercises raises EPS, as losses are shared across a larger number of shares. We therefore study whether these results are sensitive to whether we only include firms that have positive income. The underlying concern is that perhaps the firms with positive income do engage in anti-dilutive repurchases, but firms with negative income do not, and the "full sample" coefficients are moderated by the latter firms. In Table A.2, we repeat the regressions in Table 7 where we limit the sample to firms that have positive earnings (measured as income before extraordinary items). We find that the coefficients of positive price gaps on repurchases remain small and insignificant (and often negative). These results show that the lack of anti-dilutive buybacks is not confounded by firms that have negative incomes.

We further investigate whether firms engage in anti-dilutive share repurchases with a delay. Such delayed buybacks are plausible if it takes some time for firms to respond to the exercise, or if firms seek to avoid market impact from buying back a lot of shares in short order. To examine this question, we consider the impact on repurchases in the following quarter as well as over the next full year (the average over four quarters, starting with the quarter when the option expired). Results for the next-quarter repurchases are reported in Panel A of Table A.3, and for full-year repurchases in Panel B. If firms engage in anti-dilutive buybacks in response to exercises, we should again observe a significant and positive coefficient for the price gap indicator. However, we only observe statistically and economically insignificant coefficients of repurchases over both of these alternative horizons.

In summary, by examining options that expire near the zero price gap threshold using a fuzzy RD framework, we do not find evidence of a causal relationship between exercises and repurchases. This holds even when we consider only the largest options and when we consider longer time windows over which firms may conduct such repurchases.

7.3 Real and accruals-based earnings management

Option exercises exert a decreasing force on EPS due to the expansion of shares, especially as we show that these exercises are not countered by share repurchases. Firms nevertheless also have other tools at their disposal that can compensate for this effect by managing the *numerator*, *i.e.* earnings. We now examine the extent to which firms instead respond to EPS dilution from option exercises by managing earnings.

We analyze the effects on the two main tools firms have at their disposal to manage earnings: by cutting discretionary spending (which we proxy using changes to R&D spending, as in (Baber et al., 1991; Dechow and Sloan, 1991; Roychowdhury, 2006)), or by managing accruals (Dechow et al., 1995). Because firms with positive or negative income before extraordinary items face very different incentives to engage in earnings management when faced with option exercises (the firms with negative income experience better EPS when faced with dilution), we further partition the sample by the sign of income. Table 8 presents results of the effects of price gaps on real (Panel A) and accruals-based (Panel B) earnings management.

[Insert Table 8 about here]

In Panel A, we show that firms with positive price gaps decrease R&D investment more than the ones with negative price gaps. This effect is significant only among firms that have positive income. The firms with negative income here thus also serve as a kind of placebo: If there were some still-omitted spurious factor that was causing a discontinuous effect around the threshold, we would expect that factor to also be at work for the firms with negative income.

In Panel B, we examine whether the firms that end up on either side of the zero-price-gap threshold differentially alter their accruals. We employ three measures of accruals:

changes in absolute discretionary accruals (estimated using the Jones model), changes in time-adjusted absolute discretionary accruals (where we subtract the quarterly average accruals across all firms from both the pre- and post- periods), and changes to absolute total accruals. The coefficients of positive price gaps on accruals are around 1.1% - 1.4% (relative to lagged assets) within the sub-sample of positive income earners, which implies a higher intensity of earnings management among the firms that experience plausibly exogenous option exercises. The effects are also only significant among firms with positive earnings.

Figure 5 illustrates these results graphically. If firms engage in earnings management, we would expect a discrete fall to a lower level of R&D investment, and a discrete jump to a higher level of accruals around the zero price gap threshold. Panel A plots the change in R&D investment on bins of the price gap. The graph shows that firms with slightly positive price gaps experience a decrease in R&D spending compared to firms with slightly negative price gaps. Panel B plots the change in discretionary accruals on bins of the price gap. Firms on the right-hand side of the zero price gap threshold experience a sharp increase in discretionary accruals compared to firms on the left-hand side of the threshold. Panel C draws the change in adjusted discretionary accruals on bins of price gaps on expiration day, and it yields a similar result as Panel B.

[Insert Figure 5 about here]

In summary, we find that firms respond to share dilution from option exercises through real and accruals-based earnings management. This result also speaks to why we do not observe an increased intensity in share repurchases in response to exercises: firms instead employ other, and perhaps easier, ways of managing earnings to meet/beat their EPS targets. That is, instead of using repurchases to bring back the denominator, firms increase the numerator by boosting earnings.

These findings also importantly shed new light on previous research. Other papers have found associations between exercises, R&D spending, and accruals, but have interpreted their findings differently. Bens et al. (2002) shows that option exercises are correlated with lower R&D, but attribute this to firms shifting money away from R&D so that they can direct money towards anti-dilutive repurchase shares instead. We show that firms do not seem to increase repurchases around exercises, but we instead provide evidence that the reduced R&D spending is likely to be a form of earnings management. Bergstresser and Philippon (2006) show that firms engage in more accruals management around option exercises, but attribute this to opportunistic exercises by managers during times of higher earnings management. In their argument, exercises are thus an endogenous response to high accruals, whereas our identification strategy shows that at least part of the observed correlation between exercises and accruals is a causal link from (exogenous) exercises to accruals as the endogenous response in order to manage EPS around these exercises.

7.4 Actual EPS changes

The results in the previous sections have shown that option exercises we study have a denominator-driven negative effect on EPS, that firms do not buy back more shares in response to these exercises, but instead bring up the numerator. What's the net effect on actual EPS from the depressed denominator but higher numerator? In this section, we use the same empirical framework to examine what happens to actual changes in EPS that take both changes in the numerator and denominator into account. Table 9 presents results.

[Insert Table 9 about here]

The dependent variables are changes in diluted EPS in Columns 1-2 and basic EPS in Columns 3-4. In contrast to the "mechanical" decrease in EPS that's driven by the denominator, we find that the actual EPS changes for firms with slightly positive price gaps are significantly larger than the ones for firms with negative price gaps. The coefficient on the positive price gap indicator is 1.9 cents for changes to both diluted and basic EPS. These results thus show that the firms that experience a share expansion due to option exercises exhibit even larger offsetting increases in earnings, driven at least in part by an increased intensity of earnings management as we discussed in the previous section.

7.5 Subsample analysis: When anti-dilution incentives are the strongest

The previous sections have already described results where we focus in on only the largest options and firms that have positive earnings—settings where we might expect anti-dilution incentives to be the stronger. It is nevertheless possible that only some firms and executives *care* about share dilution, and the average results are moderated by firms that do not care about dilution. To test this hypothesis, we examine the extent to which firms that use EPS as an explicit incentive measure in their executive compensation behave differently.

To that end, we first identify firms with EPS-tied compensation, by using data from the IncentiveLab database and identifying firms that have any component of compensation for any executive that is based on EPS as a performance metric in the year when the option is expiring.

Panel A of Table 10 confirms that the first stage holds—*i.e.*, a positive price gap on the expiration predicts more exercises—even among the limited set of firms that use EPS as an explicit incentive. In Panel B and C, we next look at our main outcomes, the effects on share repurchases and earnings management. We limit the sample here to firms with positive earnings since these are the only firms that should respond. Panel B shows that even among the firms that use EPS as an explicit incentive, we do not observe more share repurchases in response to options exercises.

[Insert Table 10 about here]

Panel C shows that the response on accruals-based earnings management is much stronger for firms that use EPS as an explicit incentive. This is consistent with these firms being more concerned about the dilution from option exercises. By contrast, we see no response among the firms that do not use EPS as an incentive. This is consistent with managers being more concerned about maintaining the EPS around dilution only when they are compensated for doing so. The sample of firms with no EPS incentive also serves as yet another "placebo" test, as we would expect a smaller response among these firms.[15]

8 Robustness tests

This section discusses further tests that we employ to assess the robustness of our results.

In our baseline results, we do not include observations with missing data for the "purchase of common and preferred stocks" variable in Compustat. We, therefore, redo our tests where we set any missing data to zero. The results remain similar. We also examine whether our results are sensitive to different ways of measuring repurchases. We adjust our repurchase measure for lagged repurchases, by subtracting the average repurchases during the last four quarters from the current quarter, again with similar results. We also adjust the repurchases by average repurchase in the same industry and quarter (industry classifications based on the Fama-French 49 industries). Another repurchase measurement uses a repurchase indicator, which takes on a value of one if there is a repurchase in the quarter; and zero, otherwise.

We also collect data from the SDC database on repurchase *announcements* to examine whether such announcements are more likely in quarters when options are exercised using the same regression discontinuity framework as above, but we find no evidence of an increased likelihood of new repurchase programs. These results on announcements are thus consistent with our baseline results that focus on actual repurchases.

We further test whether our results are sensitive to variations to our regression discontinuity specification. We examine whether our results are sensitive to the window size around the threshold of a zero price gap, by changing the window to [-0.15, 0.15], [-0.25,

[15] We nevertheless do not see a significant differential effect on R&D in this limited sample. Part of the reason is that the sample of firms that report R&D is significantly smaller, so when we further limit this sample to firms that we can link to IncentiveLab that use EPS and have positive income, we end up with a very small sample and thus insufficient statistical power to tell any differences apart.

0.25], [-0.3, 0.3], [-0.35, 0.35], and [-0.4, 0.4]. We also include the square of the price gap in the regression to account for a non-linear effect of the assignment variable. Table 11 reports the regression coefficients of the positive price gap indicator across a range of different bandwidths. The dependent variables include option exercises and repurchases in Panel A, and earnings management variables in Panel B. The bandwidths range from 0.15 to 0.4 with an interval of 0.05. We also include the "optimal" bandwidth based on Calonico, Cattaneo, Titiunik et al. (2014), which is 0.33. For bandwidths smaller than or equal to 0.2, we control for the linear relation with price gap, and for bandwidths larger than 0.2, we control for the linear and quadratic relation with price gap. In Panel A, the coefficients of the positive price gap indicator are significantly positive on option exercises and not significant on repurchases across all alternative bandwidths. In Panel B, the coefficients of the positive price gap are significantly negative on the change in investment for a majority of the bandwidths, and are significantly positive on the change in discretionary accruals in all alternative windows. These findings show that the previous results are robust to alternative estimation windows.

[Insert Table 11 about here]

We also check the effect of the price gap on pre-trends of outcome variables. We examine pre-trends in shares outstanding and earnings management in quarters before option expiration in Table A.4 in the Appendix. The pre-trend outcome variables are measured as the average change in the previous four quarters. We find that there are no such pre-trends in the quarters before the option expiration.

9 Concluding remarks

Many previous studies have shown a positive correlation between option exercises and share repurchases and argue that firms may seek to engage in shares buybacks to counter EPS dilution from options compensation. This correlation may nevertheless not necessarily be causal. Both exercises and share repurchases are endogenous decisions that depend on several third factors such as firm performance and life cycle and which may not all be easy to control for, and firms have at their disposal alternative tools they can use to manage EPS.

This paper examines this question using a regression discontinuity framework to identify the causal impact of quasi-exogenous option exercises on the two main ways of managing EPS: share repurchases and earnings management. We exploit a fuzzy regression discontinuity framework that focuses on options with stock prices that are close to moneyness and examine responses by firms that experience quasi-exogenous exercises because of their options ending up slightly in-the-money. Contrary to an "anti-dilution hypothesis", our results show that these quasi-exogenous exercises do not cause additional buybacks. In other words, even though firms with many options and options that are in-the-money tend to do more buybacks on average, this difference disappears once we zoom in on a smaller window where other confounding factors are held constant and where we should observe a discrete jump if firms engage in anti-dilutive repurchases. Instead, we show that firms engage in real- and accrual-based earnings management to avoid depressing EPS around option exercises.

Our results are thus most consistent with the survey evidence of Graham et al. (2005), who report that real- and accruals-based earnings management tend to be much preferred to buybacks among executives looking to meet EPS targets, and *cohen2008real* who show that outstanding options are positively correlated with accruals-based earnings management.

If firms do not engage in share repurchases to manage earnings around option exercises, why do so many managers give answers to survey questions suggestion that anti-dilution is one of the main reasons for buying back shares? We can of course only speculate why managers answer the way they do. One possibility is that managers who have repurchased shares clearly notice that one of the "uses" for the resulting treasury stock is to provide shares in connection with option exercises; but the real reason for having originally repurchased shares could still have been something else, such as flexibility or tax efficiency. In other words, *using* the treasury stock for option exercises does not mean that the reason for doing those repurchases was *because* the firm anticipated those exercises, or that a firm would have done more or less buybacks if it faced a different magnitude of option exercises.

Finally, we want to emphasize that it is still possible that other aspects of options compensation could have a causal effect on payout policy, including the fact that options typically are not dividend-protected. While our empirical framework is well-suited to directly testing the causal effect of a dilution channel, we cannot take a stand on these *other* possible mechanisms that link options with payout policy, and which are worthy of further study.

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A Definition of Variables

Adjusted strike price: Strike price as determined on the option's grant day, dividend by "cumulative factor to adjust prices" from CRSP on the grant day

Grant date: Grant date of the option from Execucomp.

Adjusted stock price on expiration date: Stock price on the option's expiration day, dividend by "cumulative factor to adjust prices" from CRSP on the expiration date

Price gap: Adjusted stock price at the option expiration date less the adjusted strike price.

Price gap indicator: 1 if Price gap is positive, and 0 otherwise.

Normalized price gap:: Price gap divided by the adjusted strike price.

Option size: For each option that expires starting in 2007, the sum of the number of options unexercised-exercisable, options unexercised-unearned, and options at unexercised-unexercisable as of the fiscal year end immediately prior to the expiration date. For options before 2007, we use the number of options from the grants table. Both measures are reduced by the cumulative number of options already exercised before the quarter of option expiration. We normalize by lagged share outstanding.

Large option indicator: 1 if the option size is in the top tercile, and 0 otherwise.

Option exercise size: The number of option exercises in the quarter of expiration (q_0), divided by lagged number of shares outstanding.

Option exercise indicator: 1 if option exercise size variable is positive, and 0 otherwise

Fraction of option exercises: The number of option exercises in the quarter of expiration, divided by option size.

Repurchases: Purchases of common and preferred stock from Compustat less any decreases in the par value of preferred stock (in $ million) in q_0 . If the value is negative, we set it equal to zero.

Repurchase indicator: 1 if Repurchases are positive, and 0 otherwise.

Log of repurchases: log (1+Repurchases).

Normalized Repurchases: Repurchases normalized by lagged total assets.

Changes in normalized Repurchases: the difference in normalized repurchases between q_0 and q_{-1}.

Dividends: Cash dividends normalized by lagged total assets.

Changes in shares outstanding: The difference in shares outstanding between q_0 and q_{-1}, normalized by shares outstanding in q_{-1}.

Changes in log shares outstanding: The difference in log of shares outstanding between q_0 and q_{-1}.

Mechanical EPS changes: These EPS changes hold the numerator constant at lagged earnings, but allow the number of shares outstanding to change between quarters q_0 and q_{-1}. In other words, it is the difference in the ratio of income before extraordinary items, available for common in q_{-1} and shares outstanding at the end of q_0, and the ratio of income before extraordinary items, available for common at the end of q_{-1} and shares outstanding at the end of q_{-1}.

Normalized mechanical EPS changes: mechanical EPS changes divided by stock price at the end of q_{-1}.

Actual diluted EPS changes: the difference in diluted EPS between q_0 and q_{-1}, normalized by stock price at the end of q_{-1}.

Actual basic EPS changes: the difference in basic EPS between q_0 and q_{-1}, normalized by stock price at the end of q_{-1}.

Changes in R&D: the difference in R&D between q_0 and q_{-1}, normalized by total assets in q_{-1}.

Changes in discretionary accruals: the differences in absolute residuals from the Jones' model between q_0 and q_{-1}

Changes in adjusted discretionary accruals: the differences in absolute residuals from the Jones model adjusted by quarters between q_0 and q_{-1}

Changes in total accruals: the differences in net income, minus changes in assets, plus changes in liabilities, and plus depreciation in absolute value between q_0 and q_{-1}

Book-to-market: the number of shares outstanding multiplies by stock price at the end of q_{-1}, divided by shareholders' equity minus preferred stock value.

Cash flow to assets: net income plus depreciation in q_{-1}, normalized by lagged total assets

Cash to assets: cash and short-term investment in q_{-1}, normalized by lagged total assets

Return on assets: net income in q_{-1} multiplies by four, normalized by lagged total assets

Total debt to assets: the sum of log-term debt and current liabilities in q_{-1}, normalized by total assets

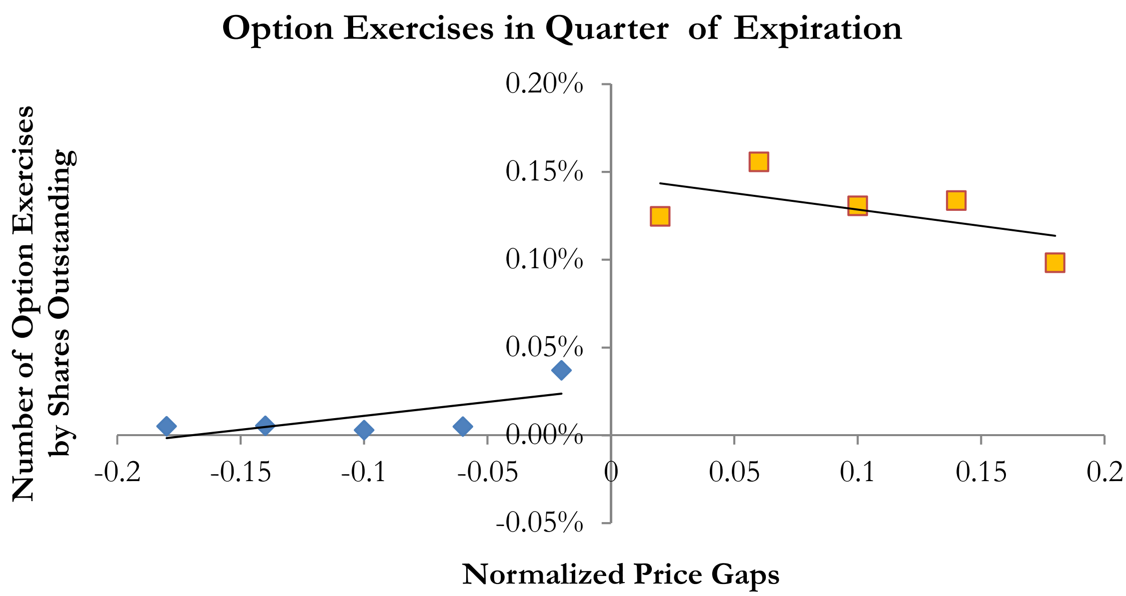
Log of assets: log of one plus total assets in q_{-1}

EPS indicator: 1 if the firm's annual proxy statement mentions "EPS" or "Earnings per share", or if at least one incentive granted or expiring in that fiscal year includes EPS as a measure; and 0 otherwise.

Figure 1 First stage: Option exercises and price gaps

This figure shows the amount of option exercises that take place during the last quarter of an option's life (y-axis) on bins of price gap on the option expiration date (x-axis), the "first stage" in our regression discontinuity design. Awards with the same expiration date and same strike price are aggregated. If a firm-quarter has multiple expiring options with different strike prices or different dates, the price gap is based on the largest option award that expires in that quarter. In Panel A, we normalize option exercises by the lagged number of shares outstanding. In Panel B, we normalize by the sum of all awards that expire in that quarter. The graph is limited to awards with a normalized price gap in the range [-0.2, 0.2] with a bin size of 0.04.

A: Option exercises normalized by shares outstanding



B: Option exercises normalized by award size

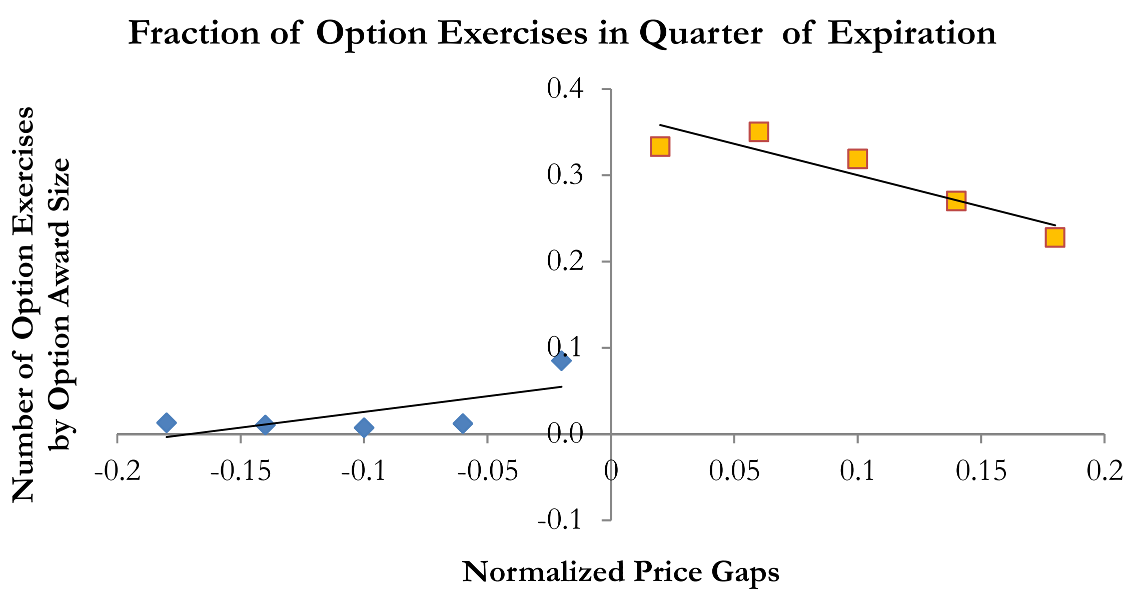
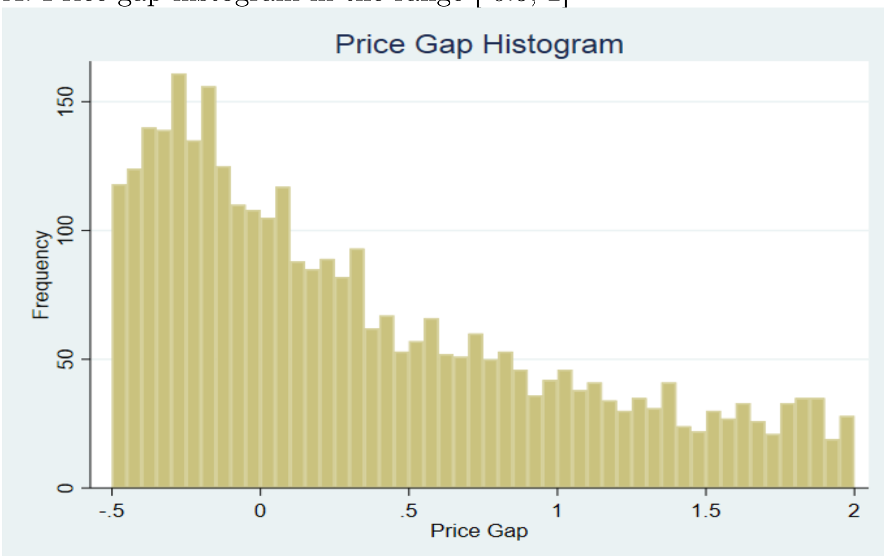


Figure 2 Non-manipulation of the assignment variable
This figure shows histograms of the normalized price gaps on each option's expiration day. Normalized price gap is measured as the stock price on the expiration date minus the option strike price (adjusted for stock splits and stock dividends between the grant date and expiration date), with this difference normalized by the strike price. Panel A shows a histogram for option awards with price gaps falling within the range [-0.5, 2], and Panel B shows the histogram within the finer range [-0.2, 0.2]. The observations are at the option level.

A: Price gap histogram in the range [-0.5, 2]



B: Price gap histogram in the range [-0.2, 0.2]

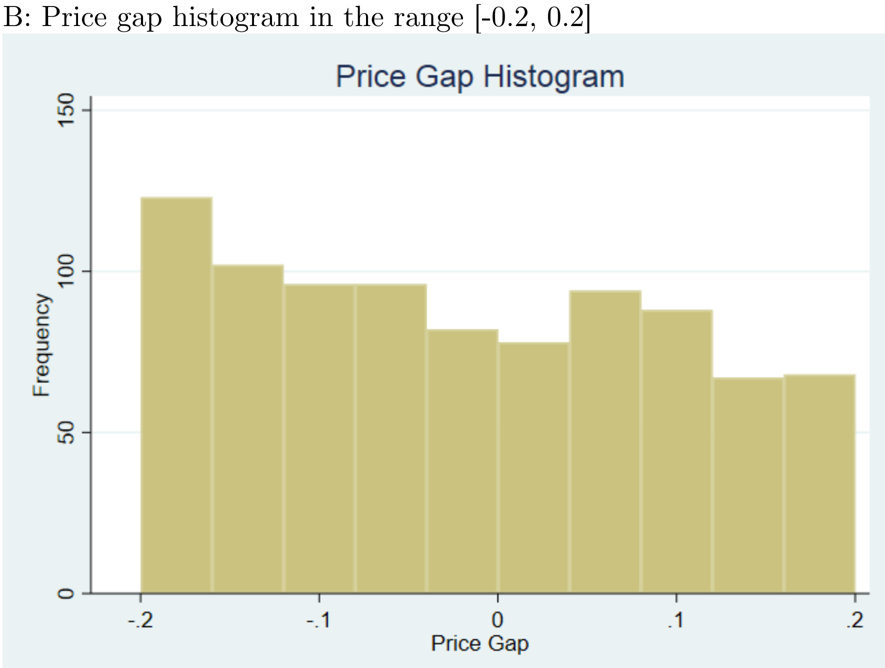


Figure 3 Share Repurchases during the quarter of option expiration
This graph shows the quarterly level of share repurchases, normalized by lagged total assets (y-axis) on bins of price gap on the option expiration date (x-axis), a principal "second stage" variable in our analysis. If a firm-quarter has multiple expiring options with different strike prices or different dates, the price gap is based on the largest option award that expires in that quarter.

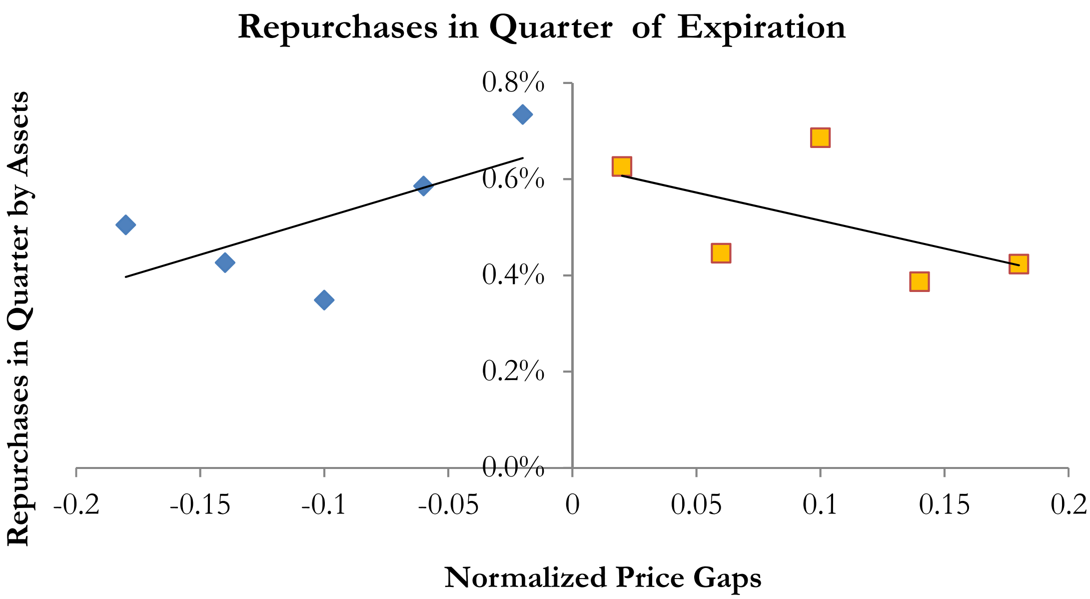
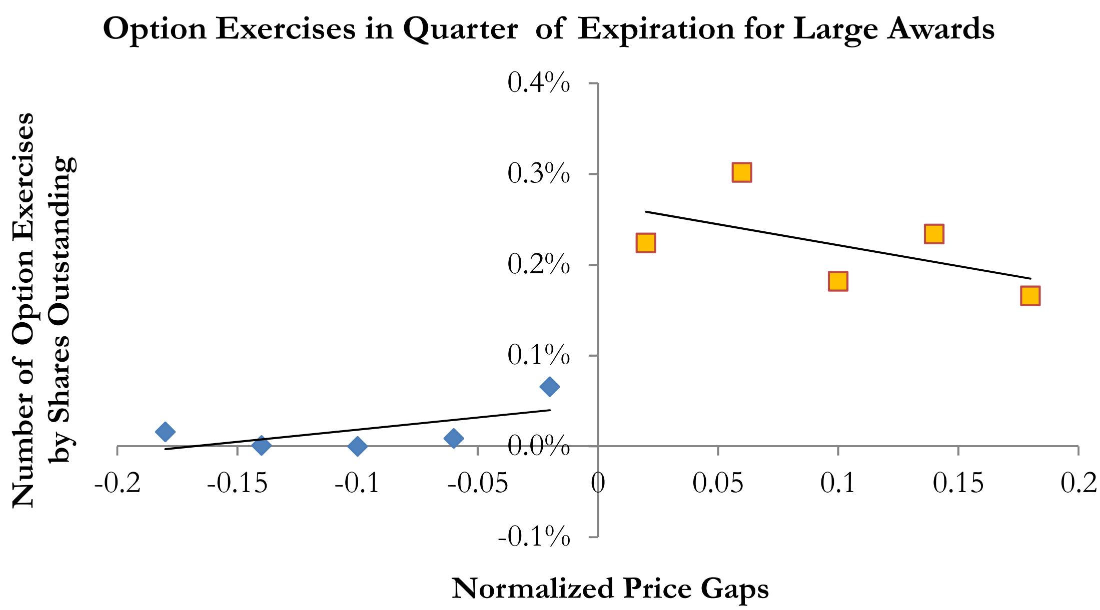


Figure 4 Exercises and Share Repurchases: The case of large option awards
This figure shows option exercises (first stage) and repurchases (second stage) within a subsample of large option awards. We define an award as "large" if the award size ranks the top tercile when measured as a fraction of lagged shares outstanding. Panel A shows the first stage (analogous to Figure 1): option exercises that take place during the last quarter of an option's life (y-axis) on bins of the price gap on the option's expiration date (x-axis). Awards with the same expiration date and same strike price are aggregated. Panel B shows the second stage (analogous to Figure 3): quarterly share repurchases, normalized by lagged total assets. If a firm-quarter has multiple "large" expiring options with different strike prices or different dates, the price gap is based on the largest option award that expires in that quarter. We limit the graphs to awards with a normalized price gap in the range [-0.2, 0.2] with a bin size of 0.04.

A: First stage. Option exercises by shares outstanding, for subsample of large option awards



B: Second stage. Repurchases normalized by assets, for subsample of large option awards

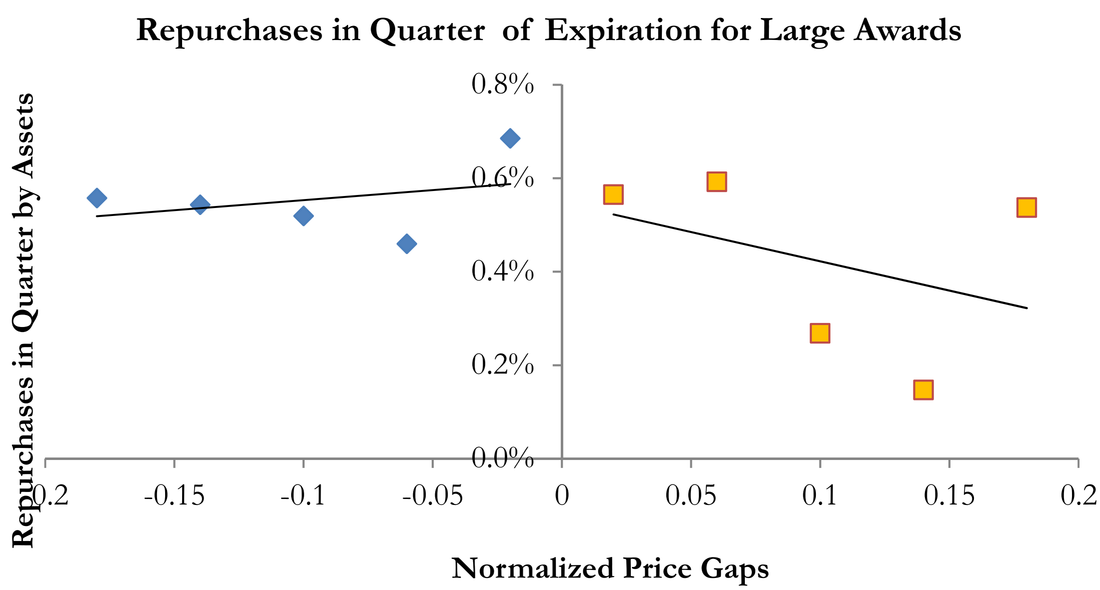
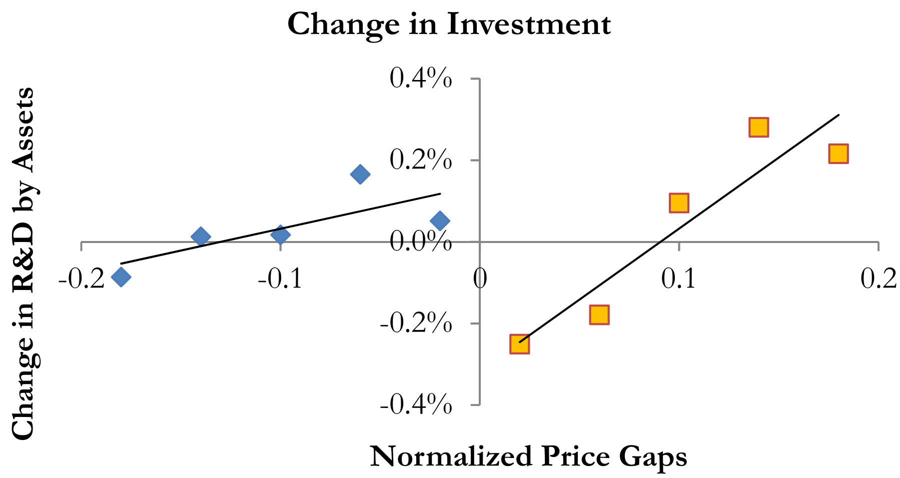


Figure 5 Earnings management during the quarter of option expiration
This graph shows the changes in R&D investment in Panel A, discretionary accruals in Panel B (y-axis) on bins of price gap on the option expiration date (x-axis).

A: Changes in R&D investment



B: Change in discretionary accruals

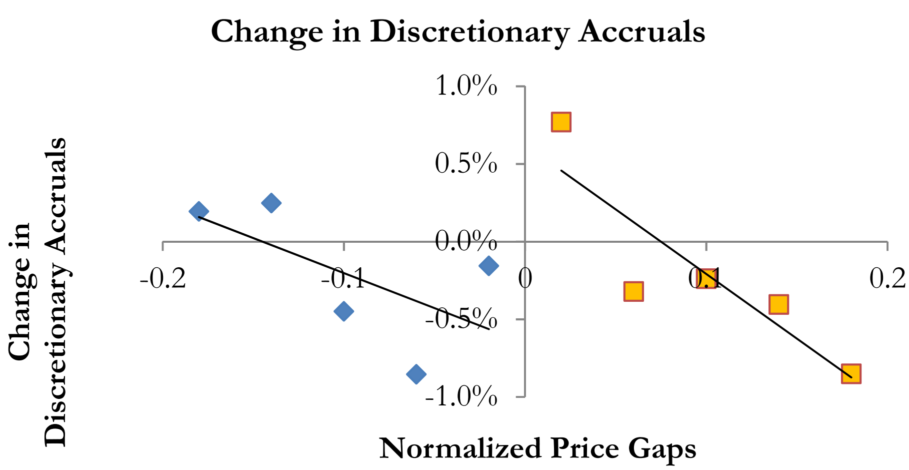


Table 1 Summary statistics

This table reports summary statistics on option award characteristics (panel A), option exercises and payout variables (panel B), other outcome variables (Panel C), and firm characteristics (panel D). The firm characteristics in panel D are measured at the end of the quarter before option expiration. We report statistics separately for all option awards (Column 1), all awards with positive price gaps on expiration (Column 2), and all awards with negative price gaps on expiration (Column 3). In Columns 4–6, we further restrict the sample to awards with a price gap in the range [-0.2, 0.2]. The observations are at the firm-quarter level; if a firm-quarter has multiple expiring options with different strike prices or different dates, the price gap is based on the largest option award that expires in that quarter. In Columns 1–6, we report mean values, and median values in parentheses. In Column 7, we report the mean difference between Columns 5 and 6, and p-values of a t-test of the difference in parentheses. The variable definitions are described in detail in the Appendix. The sample period is January 1992–June 2017. All variables are winsorized at the 1% and 99% levels. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

A: Option award-level variables

	All awards	Positive price gap	Negative price gap	Price gap [-0.2,0.2]	Price gap [0,0.2]	Price gap [-0.2,0]	t-test [0,0.2] vs. [-0.2,0]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Norm. price gap	0.9691	2.0661	-0.4431	-0.0180	0.0943	-0.1073	0.2016***
	(0.1581)	(1.1294)	(-0.4289)	(-0.0229)	(0.0900)	(-0.1113)	(0.0000)
Positive price gap	0.5628	1.0000	0.0000	0.4431	1.0000	0.0000	1.0000***
(indicator)	(1.0000)	(1.0000)	(0.0000)	(0.0000)	(1.0000)	(0.0000)	(0.0000)
Adj. strike price ($)	22.5787	15.9044	31.1705	22.5622	23.1636	22.0837	1.0799
	(14.3800)	(10.6250)	(20.5000)	(17.5600)	(16.5000)	(17.8400)	(0.6222)
Adj. stock price on	24.8116	32.3584	15.0966	22.1654	25.4917	19.5189	5.9728**
exp. date ($)	(17.7900)	(24.3700)	(10.8000)	(16.7317)	(18.5000)	(16.1400)	(0.0163)
Option award size	0.4808	0.4855	0.4746	0.4218	0.4292	0.4160	0.0132
(%)	(0.2699)	(0.2674)	(0.2735)	(0.2502)	(0.2527)	(0.2477)	(0.6956)
N	5,183	2,917	2,266	899	399	500	

B: Option exercises and firm payout variables

	All awards	Positive price gap	Negative price gap	Price gap [-0.2,0.2]	Price gap [0,0.2]	Price gap [-0.2,0]	*t*-test [0,0.2] vs. [-0.2,0]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Option exercises/Shares	0.0578	0.1006	0.0027	0.0595	0.1219	0.0099	0.1120***
outstanding (%)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.0000)
Option exercises	0.2211	0.3774	0.0199	0.2165	0.4257	0.0501	0.3756***
(indicator)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.0000)
Repurchases ($ million)	20.0586	27.4968	10.6339	23.9201	22.7220	24.8833	-2.1614
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.7716)
Repurchases/Assets (%)	0.6224	0.8111	0.3831	0.6038	0.5953	0.6105	-0.0152
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.9110)
Dividends/Assets (%)	0.1858	0.2162	0.1470	0.2331	0.2382	0.2291	0.0091
	(0.00)	(0.00)	(0.00)	(0.0222)	(0.0103)	(0.0238)	(0.7202)
N	5,183	2,917	2,266	899	399	500	

Table 1, cont.

C: Other outcome variables: Shares outstanding, EPS, earnings management

	All awards (1)	Positive price gap (2)	Negative price gap (3)	Price gap [-0.2,0.2] (4)	Price gap [0,0.2] (5)	Price gap [-0.2,0] (6)	t-test [0,0.2] vs. [-0.2,0] (7)
Change in shares	0.5803	0.5805	0.5801	0.4340	0.5962	0.3055	0.2906
outstanding (%)	(0.2067)	(0.2985)	(0.1153)	(0.2015)	(0.2996)	(0.1405)	(0.13)
Change in mechanical	0.3571	0.1127	0.6724	0.2356	0.0212	0.4048	-0.3836*
EPS (cents)	(-0.0082)	(-0.0442)	(0.0000)	(-0.0130)	(-0.0239)	(-0.0057)	(0.09)
Change in mechanical	0.0194	0.0021	0.0421	0.0098	0.0012	0.0166	-0.0154*
EPS/Share price	(-0.0006)	(-0.0021)	(0.0000)	(-0.0008)	(-0.0015)	(-0.0004)	(0.09)
Change in diluted	0.3410	0.2305	0.4885	0.0698	0.7038	-0.4326	1.1364***
EPS (cents)	(0.0456)	(0.0440)	(0.0554)	(0.0000)	(0.0000)	(0.0000)	(0.0027)
Change in basic EPS	0.3525	0.2350	0.5094	0.0744	0.7078	-0.4287	1.1365***
(cents)	(0.0496)	(0.0476)	(0.0592)	(0.0000)	(0.0117)	(0.0000)	(0.0033)
Change in R&D (% of	0.0662	0.1332	-0.0090	-0.0004	0.0409	-0.0295	0.0704
assets)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.3947)
Change in total	-0.2027	-0.2463	-0.1456	-0.2895	-0.3124	-0.2712	-0.0412
accruals (*100)	(-0.1178)	(-0.0816)	(-0.1576)	(-0.1619)	(-0.0957)	(-0.2157)	(0.8854)
Change in discr.	-0.1475	-0.1940	-0.0865	-0.1787	-0.2114	-0.1527	-0.0587
accruals (*100)	(-0.0681)	(-0.0489)	(-0.0848)	(-0.1394)	(-0.0472)	(-0.1684)	(0.8381)
Change in cash	0.1331	0.4547	-0.2807	0.0937	0.1500	0.0488	0.1011
	(0.0503)	(0.1427)	(-0.0601)	(0.0562)	(0.0789)	(0.0222)	(0.80)
Change in issued	2.0850	1.4242	2.9055	1.2337	1.4428	1.0688	0.3740
shares (%)	(0.4329)	(0.5243)	(0.3306)	(0.3362)	(0.3540)	(0.3333)	(0.42)
N	5,063	2,803	2,260	877	380	497	

D: Control variables

	All awards (1)	Positive price gap (2)	Negative price gap (3)	Price gap [-0.2,0.2] (4)	Price gap [0,0.2] (5)	Price gap [-0.2,0] (6)	t-test [0,0.2] vs. [-0.2,0] (7)
Market-to-book	2.8076	3.1737	2.3133	2.2590	2.4601	2.0964	0.3638
	(1.8760)	(2.2482)	(1.3635)	(1.5895)	(1.6906)	(1.5131)	(0.1071)
Cash flow/Assets	0.9613	2.1363	-0.5735	1.2483	1.3794	1.1425	0.2369
(%)	(1.8252)	(2.2613)	(1.2149)	(1.8093)	(1.7872)	(1.8183)	(0.5364)
Cash/Assets	0.1630	0.1499	0.1799	0.1509	0.1472	0.1539	-0.0067
	(0.0877)	(0.0747)	(0.1055)	(0.0819)	(0.0727)	(0.0881)	(0.5744)
ROA	0.0061	4.5317	-5.8333	1.0319	1.1821	0.9127	0.2695
	(3.3401)	(5.0761)	(1.0457)	(2.9648)	(3.0263)	(2.9441)	(0.8368)
Total debt/Assets	0.2295	0.2206	0.2409	0.2222	0.2242	0.2206	0.3631
	(0.2002)	(0.2041)	(0.1963)	(0.1960)	(0.2112)	(0.1850)	(0.7993)
Assets (Log)	7.0273	7.3429	6.6210	7.1185	7.0966	7.1360	-0.0393
	(6.9215)	(7.2709)	(6.4941)	(6.9996)	(7.0109)	(6.9551)	(0.7120)
EPS incentive	0.3192	0.3253	0.3084	0.3750	0.3452	0.4000	-0.0548
indicator	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.2810)
N	5,183	2,917	2,266	899	399	500	

Table 2 OLS regressions of repurchases on options compensation

This table reports OLS regression of repurchases on options compensation during 1992 to 2017. The variables are at the firm-year level. Repurchases are measured as log (dollar value of share repurchase +1). Options compensation are measured as the log(dollar value of option grants+1), log(dollar value of option exercises+1), and log(dollar value of unexercised but exercisable options+1), where the options variables are summed over all named executive officers within a firm-year. Firm control variables include firm age, cash to assets, earnings volatility, past 1-year, 5-year and 10-year stock returns, market-to-book, ROA, and firm size (log of assets). These control variables are measured as of the end of the previous fiscal year. Panel A drops observations with assets less than 1 million or with non-positive book value of equity. Panel B further restricts to firm-year observations with negative income. All variables are winsorized at the 1% and 99% levels. *t*-statistics based on standard errors that are robust to heteroskedasticity and clustered by firm are reported in brackets. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: all firm-year observations

Dependent variable: Log ($ Share Repurchases)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log ($Options awarded)	0.119***			0.037***	0.014***	0.010***	0.009**
	(17.52)			(6.21)	(2.62)	(2.88)	(2.05)
Log ($Options exercised)		0.184***		0.122***	0.064***	0.052***	0.049***
		(34.87)		(26.08)	(15.00)	(13.97)	(13.46)
Log ($Unexercised exercisable options)			0.177***	0.085***	0.042***	0.045***	0.052***
			(29.92)	(16.08)	(8.65)	(11.44)	(11.24)
Earnings volatility					0.004	0.006***	
					(1.38)	(2.89)	
1-year return					-0.10***	-0.10***	
					(3.87)	(2.90)	
5-year return					0.062***	0.020**	
					(7.20)	(2.18)	
10-year return					-0.015*	0.026***	
					(1.79)	(3.96)	
Cash/Assets					1.750***	1.391***	
					(15.18)	(18.78)	
Firm age					0.006***	-0.007***	
					(3.45)	(7.79)	
Market-to-book					0.043***	0.031***	
					(9.71)	(9.98)	
ROA					2.577***	2.196***	
					(15.05)	(13.12)	
Firm size					0.654***	0.634***	
					(41.59)	(54.01)	
Firm FE	No	No	No	No	No	No	Yes
Ind.*Year FE	No	No	No	No	No	Yes	Yes
R^2	0.033	0.093	0.082	0.111	0.318	0.412	0.564
N	42,257	42,261	42,265	42,247	37,105	37,064	42,140

Table 2, cont.

Panel B: firm-year observations with negative income

Dependent variable: Log ($ Share Repurchases)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log ($Options awarded)	0.035***			0.009	-0.003	-0.006	-0.010
	(4.79)			(1.23)	(-0.44)	(-0.76)	(-1.08)
Log ($Options exercised)		0.094***		0.083***	0.052***	0.045***	0.034***
		(11.75)		(10.05)	(6.35)	(5.37)	(3.88)
Log ($Unexercised			0.057***	0.015**	0.011	0.025***	0.020**
exercisable options)			(8.08)	(2.05)	(1.54)	(3.28)	(2.25)
Earnings volatility					-0.003**	-0.000	
					(-2.24)	(-0.15)	
1-year return					0.103**	0.126**	
					(2.51)	(2.18)	
5-year return					0.073***	0.028**	
					(6.39)	(2.10)	
10-year return					-0.023**	0.009	
					(-2.25)	(0.82)	
Cash/Assets					0.745***	0.552***	
					(6.05)	(3.91)	
Firm age					0.009***	0.000	
					(4.28)	(0.13)	
Market-to-book					-0.013***	-0.013***	
					(-3.00)	(-3.02)	
ROA					0.519***	0.426***	
					(6.42)	(5.20)	
Firm size					0.323***	0.320***	
					(16.35)	(16.76)	
Firm FE	No	No	No	No	No	No	Yes
Ind.*Year FE	No	No	No	No	No	Yes	Yes
R^2	0.006	0.037	0.017	0.039	0.164	0.325	0.587
N	6,993	6,993	6,995	6,989	6,160	5,944	6,089

Table 3 First stage: Price gap and option exercises
This table reports results for the relation between option price gaps on the expiration date and option exercises. The observations are at the firm-quarter level. The dependent variable is an indicator for any exercise of options that expire during the quarter (columns 1-2); or, the sum of exercises of expiring options, normalized by shares outstanding (columns 3-5). We limit the sample to awards that fall in the price gap range [-0.2, 0.2]. If a firm-quarter has multiple expiring options with different strike prices or different expiration dates, the price gap is based on the largest option award that expires in that quarter. As independent variables, Columns 1 and 3 include only an indicator for whether the price gap is positive; Columns 2 and 4 control linearly for the size of the price gap; and Column 5 interacts the positive price gap indicator with the option award size. Option award size is measured as the number of options normalized by lagged shares outstanding. The variable definitions are described in detail in the Appendix. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variables:	Option Exercise Indicator		Option Exercises		
	(1)	(2)	(3)	(4)	(5)
I(Price Gap>0)	0.376***	0.290***	0.120***	0.119***	0.089***
	(15.23)	(5.82)	(9.99)	(4.87)	(3.47)
Price Gap		0.632**		0.153	0.154
		(2.24)		(1.11)	(1.13)
I(Price Gap>0) * Price Gap		-0.44		-0.308	-0.341
		(-1.02)		(-1.46)	(-1.63)
Option Award Size					0.009
					(0.65)
I(Price Gap>0) * Option award size					0.074***
					(3.25)
R^2	0.206	0.21	0.1	0.102	0.124
N	899	899	899	899	899

Table 4 First stage: Option award size terciles

This table reports sample splits based on Columns 3 and 4 of Table 2, with subsamples based on the option award size. The observations are at the firm-quarter level, and the variables and sample are the same as in Table 2. The sample splits are based on the number of options underlying the award (summed across all awards with the same expiration date and exercise price), normalized by lagged shares outstanding. Columns 1-2 report results for the bottom tercile (smallest awards), Columns 3-4 for the middle tercile, and Columns 5-6 for the top tercile (largest awards). *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variables: Option Exercises						
	Bottom Tercile		Middle Tercile		Top Tercile	
	(1)	(2)	(3)	(4)	(5)	(6)
I(Price Gap>0)	0.049***	0.020	0.099***	0.145***	0.208***	0.224***
	(6.48)	(1.34)	(6.79)	(4.93)	(6.76)	(3.54)
Price Gap		0.110		0.090		0.255
		(1.3)		(0.53)		(0.73)
I(Price Gap>0)*		0.081		-0.680***		-0.682
Price Gap		(0.61)		(-2.62)		(-1.28)
R^2	0.124	0.139	0.134	0.16	0.134	0.138
N	300	300	300	300	299	299

Table 5 Consequences for shares outstanding

This table reports results on the relation between option price gaps on expiration and changes in shares outstanding. In Panel A, the dependent variable is the difference in shares outstanding between the end of the quarter of option expiration ("q_0") and the end of the previous quarter ("q_{-1}"), normalized by the shares outstanding in q_{-1}. In Panel B, the dependent variable is the difference in *log* shares outstanding from q_{-1} to q_0. We limit the sample to awards that fall in the price gap range [-0.2, 0.2]. Columns 1-2 include all such awards, and Columns 3-4 further limit the sample to only large option awards (in the top tercile). *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

A: Percent change in shares outstanding

Dependent variable: (shares in q_0 – shares in q_{-1})/shares in q_{-1} (%)	All awards		Large awards	
	(1)	(2)	(3)	(4)
I(Price Gap>0)	0.291	0.588	1.020**	1.584*
	(1.52)	(1.52)	(2.51)	(1.90)
Linear controls	No	Yes	No	Yes
R^2	0.003	0.004	0.021	0.024
N	896	896	299	299

B: Change in log shares outstanding

Dependent variable: log shares in q_0 – log shares in q_{-1}	All awards		Large awards	
	(1)	(2)	(3)	(4)
I(Price Gap>0)	0.296	0.621*	0.965**	1.478*
	(1.64)	(1.69)	(2.53)	(1.89)
Linear controls	No	Yes	No	Yes
R^2	0.003	0.004	0.021	0.024
N	898	898	299	299

Table 6 Denominator-driven consequences for EPS

This table reports results on the relation between option price gaps on expiration and "denominator-driven" changes in earnings per share (EPS). The dependent variable in Panel A is "Income before extraordinary items available for common" in the quarter before option expiration ("q_{-1}") dividend by shares outstanding at the end of quarter of option expiration ("q_0"), minus the same income measure divided by shares outstanding in q_{-1}. In Panel B, we further normalize these denominator-driven changes in EPS by the lagged stock price. We limit the sample to awards that fall in the price gap range [-0.2, 0.2]. Columns 1-2 include awards belong to firms with positive income, Columns 3-4 contain awards in firms with negative income, and Columns 5-6 further limit the sample to only large option awards (in the top tercile) and have positive income. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

A: Denominator-driven EPS changes

Dependent variable: (Income in q_{-1}/Shares in q_0) – (Income in q_{-1}/Shares in q_{-1}) (cents)						
	Positive income		Negative income		Large awards & positive income	
	(1)	(2)	(3)	(4)	(5)	(6)
I(Price Gap>0)	-0.265**	-0.682***	-0.649	1.008	-0.621**	-1.560***
	(-2.29)	(-2.92)	(-0.68)	(0.52)	(-2.42)	(-2.95)
Linear controls	No	Yes	No	Yes	No	Yes
R^2	0.008	0.014	0.002	0.008	0.027	0.048
N	693	693	200	200	214	214

B: Normalized denominator-driven EPS changes

Dependent variable: [(Income in q_{-1}/Shares in q_0) – (Income in q_{-1}/Shares in q_{-1})] / Price q_{-1}						
	Positive income		Negative income		Large awards & positive income	
	(1)	(2)	(3)	(4)	(5)	(6)
I(Price Gap>0)	-0.008	-0.025**	-0.036	-0.023	-0.022*	-0.053**
	(-1.44)	(-2.28)	(-0.99)	(-0.31)	(-1.71)	(-1.99)
Linear controls	No	Yes	No	Yes	No	Yes
R^2	0.003	0.009	0.005	0.005	0.014	0.022
N	693	693	200	200	214	214

Table 7 Share repurchases in the quarter of option expiration

The following tables report results on the relation between option price gaps on expiration and share repurchases. We measure share repurchases as the "purchase of common and preferred stocks", minus the maximum of zero and any negative change in the value of preferred stock on the balance sheet. In Panel A, the dependent variable is the dollar amount of share repurchases in the same quarter as the option expiration ("q_0"), normalized by lagged assets. In Panel B, the dependent variable is the difference in share repurchases normalized by assets between q_0 and q_{-1}. We limit the sample to awards that fall in the price gap range [-0.2, 0.2]. Columns 1-2 include all such awards, and Columns 3-4 further limit the sample to only large option awards (in the top tercile). *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

A: Share Repurchases (q_0)

Dependent variable: Share Repurchases / Lagged Assets	All awards		Large awards	
	(1)	(2)	(3)	(4)
I(Price Gap>0)	0.012	-0.054	-0.116	-0.044
	(0.13)	(-0.30)	(-0.81)	(-0.15)
Price Gap		1.209		0.213
		(1.2)		(0.13)
I(Price Gap>0)* Price Gap		-1.906		-1.172
		(-1.24)		(-0.46)
R^2	0.000	0.002	0.002	0.003
N	831	831	272	272

B: Change in Share Repurchases

Dependent variable: ΔShare Repurchases/ Lagged Assets, from q_{-1} to q_0	All awards		Large awards	
	(1)	(2)	(3)	(4)
I(Price Gap>0)	0.135	0.019	0.228	-0.256
	(1.13)	(0.08)	(1.02)	(-0.54)
Price Gap		0.525		0.334
		(0.38)		(0.13)
I(Price Gap>0)* Price Gap		0.101		4.111
		(0.05)		(1.03)
R^2	0.002	0.002	0.004	0.013
N	776	776	261	261

Table 8 Consequences for Real- and Accruals-based Earnings Management

The following tables report the relation between the option price gap and earnings management. In Panel A, the dependent variable is the change in R&D, which is the change in research and development expenses normalized by lagged assets from q_{-1} to q_0. In Panel B, the dependent variables are changes in different measures of accruals from q_{-1} to q_0. The different accruals measures are: absolute discretionary accruals based on the Jones model (columns 1-2), absolute discretionary accruals based on the Jones model, adjusted by the average level of discretionary accruals in each quarter (columns 3-4), and total absolute accruals (columns 5-6). We split the sample throughout based on whether income before extraordinary items is positive or negative, and report subsample results in alternate columns. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

A: Real earnings management: R&D

Dependent variable: Δ R&D		
	Sample: Positive income (1)	Sample: Negative income (2)
I(Price Gap>0)	-0.381**	-0.280
	(-2.18)	(-0.68)
Linear controls	Yes	Yes
R^2	0.029	0.034
N	259	99

B: Accruals-based earnings management

Dependent variable:	ΔDiscretionary Accruals		Δ Discretionary Accruals, time-adjusted		Δ Total Accruals	
Sample:	Positive income (1)	Negative income (2)	Positive income (3)	Negative income (4)	Positive income (5)	Negative income (6)
I(Price Gap>0)	1.427**	-1.030	1.388**	-1.363	1.117*	-0.487
	(2.42)	(-0.63)	(2.36)	(-0.85)	(1.91)	(-0.30)
Linear controls	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.016	0.003	0.014	0.005	0.011	0.001
N	522	157	522	157	522	157

Table 9 Actual EPS changes

The following tables report the relation between option price gaps on expiration and actual changes in earnings per share (EPS). In columns 1-2, the dependent variable is the change in diluted earnings per share from q_{-1} to q_0, normalized by the lagged stock price. In columns 3-4, the dependent variable is the change in basic earnings per share from q_{-1} to q_0, normalized by the lagged stock price. We limit the sample to awards that fall in the price gap range [-0.2, 0.2]. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable: Changes in actual EPS (cents)				
	Diluted EPS		Basic EPS	
	(1)	(2)	(3)	(4)
I(Price Gap>0)	1.183***	1.860**	1.163***	1.866**
	(3.09)	(2.44)	(3.02)	(2.39)
Price Gap		1.268		1.097
		(0.29)		(0.25)
I(Price Gap>0)* Price Gap		-10.141		-9.817
		(-1.53)		(-1.45)
R^2	0.011	0.014	0.01	0.013
N	892	892	893	893

Table 10 Subsample analysis: Firm s that explicitly use EPS in compensation

The following tables report results for the effect of the option price gap on exercises, share repurchases and earnings management splitting the sample based on whether the firm explicitly uses EPS in the design of compensation-based incentives or not. Panel A reports the results on exercises. Columns 1-4 include a subsample of firms that explicitly use EPS in the design of compensation-based incentives, and columns 5-8 contain firms that do not explicitly use EPS-based incentives. Panel B reports the regression results on repurchases for firms that have positive net income. Panel C reports the results on earnings management for positive income earners. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Option exercises

	Use EPS-based Compensation				Not Use EPS-based Compensation			
Dependent variables:	Exercise Indicator		Exercise size		Exercise Indicator		Exercise size	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I(Price Gap>0)	0.391***	0.349**	0.128***	0.231***	0.404***	0.292***	0.094***	0.093**
	(5.91)	(2.58)	(3.53)	(3.16)	(8.17)	(2.97)	(4.50)	(2.24)
Linear controls	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.204	0.207	0.084	0.117	0.226	0.234	0.082	0.104
N	138	138	138	138	230	230	230	230

Panel B: Repurchases for firms that use EPS (positive income earners)

Dependent variable: Repurchases				
	Use EPS		Not use EPS	
	(1)	(2)	(3)	(4)
I(Price Gap>0)	0.1881	-0.564	-0.065	0.217
	(0.73)	(-1.08)	(-0.27)	(0.45)
Linear controls	No	Yes	No	Yes
R^2	0.005	0.027	0.000	0.006
N	119	119	160	160

C: Accruals-based earnings management (positive income earners)

Dependent variable:	ΔDiscretionary Accruals		Δ Discretionary Accruals, time-adjusted		Δ Total Accruals	
Sample:	Use EPS	Not use EPS	Use EPS	Not use EPS	Use EPS	Not use EPS
	(1)	(2)	(3)	(4)	(5)	(6)
I(Price Gap>0)	3.936***	0.041	3.776***	0.604	2.468**	0.223
	(3.30)	(0.03)	(2.91)	(0.52)	(2.22)	(0.18)
Linear controls	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.133	0.014	0.105	0.016	0.066	0.042
N	90	125	90	125	90	125

Table 11 Robustness check using alternative RD bandwidths

This table reports the regression coefficients of positive price gap indicator on option exercises, repurchases, and earnings management across a range of different bandwidths. In Panel A, the dependent variables are option exercises and repurchases. In Panel B, the dependent variables are changes in investment and accruals management. For bandwidths less than or equal to 0.20, we include linear controls of price gap. For bandwidths more than 0.20, we include both linear and quadratic controls.

Panel A: Option exercises and repurchases

Independent variable of interest: I(Price Gap>0)			
Bandwidth	Exercise indicator	Exercise size	Repurchase size
	(1)	(2)	(3)
0.15	0.219***	0.110***	-0.190
	(3.60)	(3.60)	(-0.90)
0.2	0.290***	0.119***	-0.054
	(5.82)	(4.87)	(-0.30)
0.25	0.166**	0.098***	-0.140
	(2.50)	(3.05)	(-0.59)
0.3	0.234***	0.100***	-0.110
	(3.95)	(3.65)	(-0.53)
0.33	0.231***	0.095***	-0.044
	(4.51)	(3.77)	(-0.22)
0.35	0.224***	0.092***	-0.049
	(4.14)	(3.80)	(-0.25)
0.4	0.275***	0.117***	0.024
	(5.54)	(4.94)	(0.13)

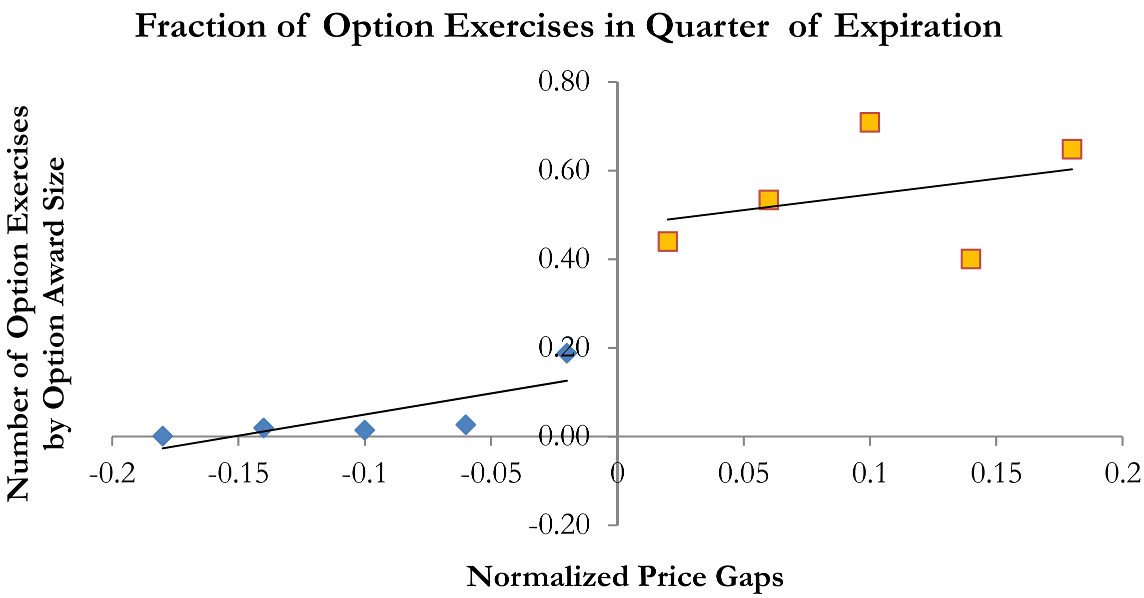
Panel B: changes in investment and accruals

Independent variable of interest: I(Price Gap>0)			
Bandwidth	Δ investment	Δ discretionary accruals	Δ adj. discretionary accruals
	(1)	(2)	(3)
0.15	-0.503***	1.398*	1.327*
	(-2.88)	(1.94)	(1.83)
0.2	-0.381**	1.427**	1.388**
	(-2.18)	(2.42)	(2.36)
0.25	-0.593***	2.091**	2.077**
	(-2.62)	(2.54)	(2.52)
0.3	-0.558***	1.658**	1.540**
	(-2.81)	(2.22)	(2.06)
0.33	-0.301	1.484**	1.375*
	(-1.10)	(2.08)	(1.93)
0.35	-0.376	1.313*	1.220*
	(-1.44)	(1.90)	(1.77)
0.4	-0.457**	1.201*	1.145*
	(-1.97)	(1.86)	(1.78)

Figure A.1 Only post-2006 dataset

The following figures show option exercises (Panel A) and repurchases (Panel B) for option awards that are still outstanding after the 2006 compensation disclosure reform. Panel A is analogous to Figure 1.B, and Panel B is analogous to Figure 3.

A: Option exercises normalized by award size, post-2006 dataset



B: Share Repurchases/Assets, post-2006 dataset

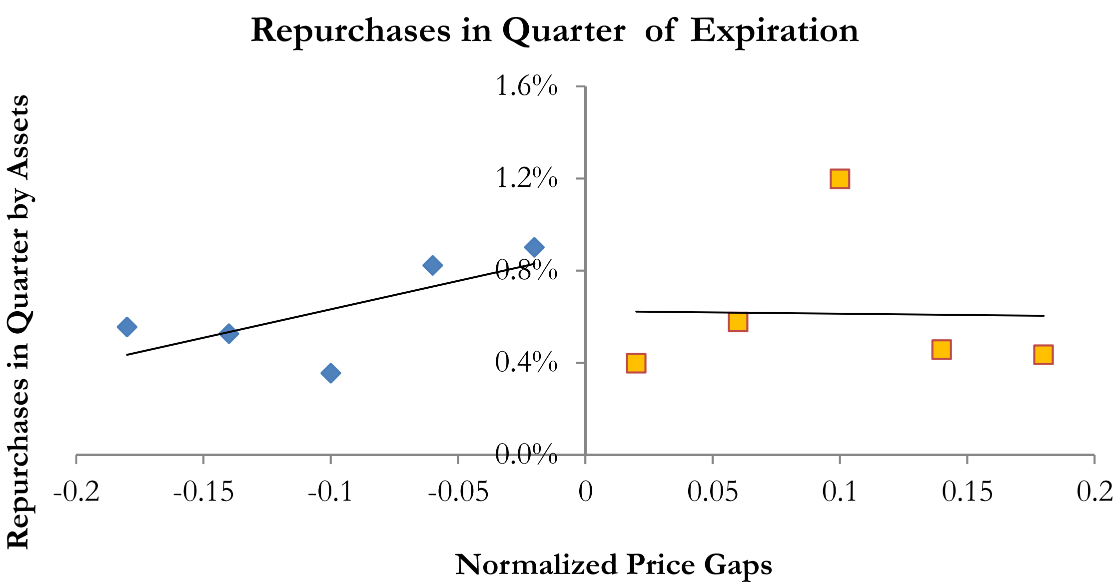


Table A.1 Summary statistics of payout variables for all firms in Compustat

This table reports summary statistics of payout variables for all firms in Compustat between 1991 and 2017. The payout variables are quarterly share repurchases in millions of dollars, repurchases normalized by lagged assets, and dividend payments normalized by assets. Column 1 presents statistics for all firm-quarters in the Compustat; Column 2 includes all firms matched between Compustat and ExecuComp; Column 3 limits the sample to only firms that have not awarded any options during the sample period; Column 4 limits the sample to only firms that have awarded options at some point during the sample period; and Column 5 limits the sample to firm-quarters after having first awarded options. The reported figures are the mean values (standard deviation in parentheses).

	All firm-quarters	All firms matched to ExecuComp	Matched firms that never had awarded options	Firms that have awarded options	Firm-quarters after first option award
	(1)	(2)	(3)	(4)	(5)
Repurchases, $million	6.4568	19.9042	6.3757	20.2583	22.3566
	(33.9285)	(57.9232)	(27,.7927)	(58.4619)	(61.1761)
Repurchases/Assets (%)	0.1998	0.4468	0.2982	0.4507	0.4789
	(0.7720)	(1.1066)	(0.9450)	(1.1110)	(1.1376)
Dividends/Assets (%)	0.2137	0.3026	0.5550	0.2961	0.2982
	(1.6477)	(0.5982)	(0.8558)	(0.5886)	(0.5654)
N	823,843	217,703	5,472	212,231	189,973

Table A.2 Share repurchases in the quarter of option expiration: Only firms with positive income
This table replicates Table 7 among only those firms that have positive net income in the quarter.

A: Repurchases in Q0

Dependent variable: Repurchases in Q0	All awards		Large awards	
	(1)	(2)	(3)	(4)
I(Price Gap>0)	-0.098	-0.248	-0.221	-0.287
	(-0.94)	(-1.17)	(-1.23)	(-0.75)
Price Gap		1.903		1.484
		(1.59)		(0.68)
I(Price Gap>0)* Price Gap		-2.493		-2.503
		(-1.37)		(-0.79)
R^2	0.001	0.006	0.008	0.01
N	648	648	212	212

B: Changes in repurchase in Q0

Dependent variable: Changes in repurchases in Q0	All awards		Large awards	
	(1)	(2)	(3)	(4)
I(Price Gap>0)	0.170	0.092	0.309	0.165
	(1.20)	(0.32)	(1.15)	(0.29)
Price Gap		-0.407		-3.523
		(-0.25)		(-1.08)
I(Price Gap>0)* Price Gap		1.688		8.866*
		(0.68)		(1.86)
R^2	0.002	0.003	0.006	0.024
N	607	607	204	204

Table A.3 Share repurchases in quarter immediately after option expiration
This table is similar to Table 7, except that the dependent variable (share repurchases) is measured as of the quarter after the option expiration (Panel A), or as the sum of repurchases during the four quarters that follows the option expiration (including the quarter of expiration (Panel B).

Panel A: Quarter after option expired

Dependent variable: Repurchases in Q1	All awards		Large awards	
	(1)	(2)	(3)	(4)
I(Price Gap>0)	0.112	-0.147	0.097	-0.085
	(1.29)	(-0.83)	(0.67)	(-0.28)
Price Gap		1.104		0.160
		(1.11)		(0.09)
I(Price Gap>0)* Price Gap		0.371		1.481
		(0.24)		(0.58)
R^2	0.002	0.006	0.002	0.004
N	801	801	269	269

Panel B: Full year after option expired

Dependent variable: Repurchases in the first year	All awards		Large awards	
	(1)	(2)	(3)	(4)
I(Price Gap>0)	0.079	-0.200	0.027	-0.482
	(0.97)	(-1.22)	(0.18)	(-1.54)
Price Gap		1.605*		1.545
		(1.73)		(0.88)
I(Price Gap>0)* Price Gap		-0.474		1.852
		(-0.33)		(0.70)
R^2	0.002	0.006	0.000	0.013
N	801	801	283	283

Table A.4 Pre-trends of outcome variables

The following table reports results for the effect of the option price gap on lagged changes in shares outstanding in Column 1, shares issued in Column 2, and earnings management variables in Columns 3-5. The lagged variables are defined as the average change from q_{-5} to q_{-4}, q_{-4} to q_{-3}, q_{-3} to q_{-2}, and q_{-2} to q_{-1}. Columns 1-2 use all options, and Columns 3-5 conditional on having positive income, as in Table 10.*, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variables:	Δ shares outstanding	Δ log shares outstanding	Δ investment	Δ discretionary accruals	Δ adjusted discretionary accruals
	(1)	(2)	(3)	(4)	(5)
I(Price Gap>0)	-2.768	-0.934	0.060	-0.092	-0.046
	(0.22)	(-0.09)	(0.66)	(-0.63)	(-0.31)
Linear controls	Yes	Yes	Yes	Yes	Yes
R^2	0.002	0.004	0.011	0.002	0.002
N	898	777	276	553	553