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What do insiders know? Evidence from insider trading around share repurchases and SEOs*

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Abstract

We examine the nature of information contained in insider trades prior to corporate events. Insiders' net buying increases before open market share repurchase announcements and decreases before seasoned equity offers. Higher insider net buying is associated with better post-event operating performance, a reduction in undervaluation, and, for repurchases, lower post-event cost of capital. Insider trading also predicts announcement returns and long-term stock price drift following events. Overall, our results suggest that insider trades before corporate events contain information about changes both in fundamentals and in investor sentiment.

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Both corporate events and personal investment decisions of corporate insiders — insider trading — contain value-relevant information.[1] In this paper, we study the interaction between firms' decisions and insiders' actions in the context of open market share repurchases and seasoned equity offers (SEOs). While several papers have studied some aspects of this interaction separately for repurchases and SEOs,[2] none have investigated the type of information insiders may possess, for example whether the information is about operating performance, risk, or misvaluation. Further, our investigation of similarities and differences in insiders' actions around repurchases and SEOs is motivated by theories featuring both of these events. Finally, a joint study of the two events using a consistent methodology and measures of insider trading enhances the generality of our conclusions and the external validity of our results.

We analyze patterns in insider trading around these events, the nature of information contained in pre-event insider trading, and potential complementarities in insider trades and event announcements. Our empirical design, which examines both repurchases and SEOs, allows us to draw conclusions that go beyond the results of prior studies. The key finding is that insider trading prior to repurchases and SEOs is associated with future changes in (i) fundamentals, such as operating performance and the cost of capital, and (ii) firm-specific misvaluation, potentially driven by investor sentiment. Using a matched-sample approach, we find that insider trading predicts changes in the cost of capital after repurchases, but not for matched firms with similar characteristics. This finding is consistent with both the real options theory and the Q theory of investment that predict a reduction in firms' risk and expected return following exercises of

[1] Examples of value-relevant corporate events include equity issues (e.g., Heron and Lie (2004) and Billett, Flannery, and Garfinkel (2011)); share repurchases (e.g., Ben-Rephael, Oded, and Wohl (2014) Dittmar and Field (2015), and Busch and Obernberger (2017))); dividend changes (e.g., Farre-Mensa, Michaely, and Schmalz (2014)); and mergers and acquisitions (e.g., Netter, Stegemoller, and Wintoki (2011)). For analyses of value-relevant insider trading, see e.g. Lakonishok and Lee (2001), Jenter (2005), or Cohen, Malloy, and Pomorski (2012).

[2] Kahle (2002), Babenko, Tserlukevich, and Vedrashko (2012), and Bonaimé and Ryngaert (2013) examine whether the interaction between insider trading and repurchases predicts future returns, while Karpoff and Lee (1991) and Kahle (2000) study the interaction of insider trading and SEOs.

investment options. Insiders seem to actively repurchase shares in advance of such decreases in risk and cost of capital being incorporated in share prices. In addition, insider trading predicts changes in firm-specific misvaluation after SEOs, but not for matched firms. This result is consistent with insiders aiming to profit from temporary misvaluation, which is the underlying reason for many SEOs (e.g., Khan, Kogan and Serafeim (2012)).

An analysis of abnormal returns following these events shows that the value implications of corporate events are larger when insiders "put their money where their mouth is", i.e. when insider trading is in the direction of a corporate announcement. This is consistent with the existence of complementarities between the information contained in event announcements and that in insider trading. Finally, our findings suggest that prices adjust faster to information related to misvaluation that stems from investor sentiment than to information about fundamentals.

Both events have a high ex-ante potential to exhibit complementarities with insider trading. First, there is a consensus that announcements of SEOs and repurchases provide the market with significant new information, as evident from market reactions to these event announcements (e.g., Grullon and Michaely (2004), Bonaimé (2012), and Manconi, Peyer, and Vermaelen (2014) for the case of repurchases, and Ritter (2003), Carlson, Fisher, and Giammarino (2006), and Billett, Flannery, and Garfinkel (2011) for the case of SEOs).[3] Second, insiders are likely to possess superior information relative to other market participants in the months prior to these events (e.g., Myers and Majluf (1984) and Korajczyk, Lucas, and McDonald (1991)). This is consistent with surveys of CEOs, according to which misvaluation is

[3] The evidence on the informational content of other corporate events is less clear. For example, while dividend changes may also signal information, Grullon et al. (2005) show that dividend changes are not correlated with future changes in operating performance, and are negatively (not positively) correlated with future changes in profitability. Similarly, Netter et al. (2011) report that the market reaction to mergers and acquisitions depends largely on how the sample of mergers is selected.

an important reason for issuing and repurchasing equity (e.g., Graham and Harvey (2001) and Brav, Graham, Harvey, and Michaely (2005)).

Studying repurchases and SEOs jointly using large and comprehensive samples is important for two reasons. First firms often both repurchase and issue new shares within a relatively short period of time. For example, in our sample 26% of firms conduct at least one repurchase and at least one SEOs, with the mean (median) distance between two events of 3.8 (2.6) years. Moreover, 44% of events in our sample belong to firms that do both repurchases and SEOs. This evidence is in line with findings in Farre-Mensa, Michaely and Schmalz (2018), in whose sample 42% of firms that pay out capital also raise funds in the same year. In addition, even firms that do not repurchase and issue shares within a short time period, have the *option* to do so, which may impact their decisions to issue/repurchase shares in the first place.

Repeated interactions among firms and their equity holders are analyzed in theoretical models of Constantinides and Grundy (1989) and Bond and Zhong (2016). These theories demonstrate the second reason for the importance of joint exampnation of insider trading prior to repurchases and SEOs. While SEOs and repurchases may seem as each other's mirror images, both models show that this is not necessarily the case. In Constantinides and Grundy (1989), security issues are used to finance investments and do not necessarily provide signals to the market. On the other hand, repurchases do signal information in equilibrium in which part of the issue proceeds are used to repurchase shares. In Bond and Zhong (2016), undervalued firms that would avoid issuing equity to finance positive NPV projects due to SEO underpricing can signal their valuation to the market using repurchases. As a result, some firms use repurchases for purposes of information signaling and (larger) subsequent SEOs for financing of investment

opportunities. We examine whether these theoretical discrepancies in the motivations for issuing and repurchasing equity are borne out in the data.

Our analysis starts by constructing a measure of insider net buying activity, defined as the number (or dollar value) of insider purchases less the number (or dollar value) of insider sales, normalized by the total number (total dollar value) of insider trades.[4] This measure – the net purchase ratio (NPR) – ranges between 1 (if all insider transactions are purchases) and -1 (if all insider transactions are sales). We show that on average, insiders trade in the direction of the event. NPR increases from -0.35 six months prior to a repurchase to -0.2 one month prior to the announcement, indicating more insider net buying prior to repurchases, a change that is statistically significant at the 1% level. This increase corresponds to 18% of one standard deviation of NPR. For SEOs, we find a mirroring pattern that is larger in magnitude. In particular, NPR moves from -0.35 six months prior to an SEO to -0.65 one month before the announcement, a decrease that equals 40% of the standard deviation of NPR.

What do insiders know before these events? To answer this, we examine whether heterogeneity in pre-event insider net buying predicts changes in fundamentals – operating performance and cost of capital, and/or changes in firm-specific misvaluation. We then use a propensity score matching approach to obtain a sample of matched firms for both the repurchasing and SEO firms, and examine whether insider trades predict similar future changes in fundamentals for event firms and for matched firms. We find that insider trading predicts changes in the cost of capital of repurchasing firms, but not of matched peers. A one-standard-deviation increase in insider net buying is associated with a 0.30 percentage point larger decline in the cost of capital, which equals one-fifth of the average decline in the cost of capital. We do

[4] Throughout the paper, we follow the literature on insider trading and use the term "net buying" to refer to the number (or volume) of purchases less the number (or volume) of sales.

not find significant association between insider trading prior to SEOs and post-SEO changes in the cost of capital. Finally, insider trading predicts changes in operating performance similarly across both event firms and matched peers. A one-standard-deviation increase in pre-event insider net buying is associated with a 0.38 (0.49) percentage point smaller decrease in ROA three years after repurchases (SEOs), which is economically sizable given that the average change in ROA is -2.0 (-2.6) percentage points. These results, shedding light on the type of information possessed by insiders prior to SEO and repurchase announcements, are novel to the literature.

With respect to the type of fundamentals-related information contained in pre-repurchase insider trading, the finding that it is more strongly related to post-repurchase changes in the cost of capital than to changes in ROA is consistent with the hypothesis that firms repurchase shares and insiders buy shares on their own account in times of changes in firms' risk profiles. Real options theory predicts that firms' risk and cost of capital are expected to decrease following the exercise of real options, during which (riskier) options are substituted by (safer) assets in place (e.g., Carlson, Fisher and Giammarino (2004, 2006)). In addition, the Q theory of investment predicts that investment should increase as the (expected) cost of capital declines (e.g., Zhang (2005), Li, Livdan and Zhang (2009)) – a finding that we confirm in the data.

It is also possible that even if insiders do not have private information about future changes in fundamentals, they may recognize market mispricing and exploit it at both the personal level (insider trading, e.g., Seyhun (1992), Jenter (2005), and Piotroski and Roulstone (2005)) and at the firm level (repurchases and SEOs). We refer to such mispricing, driven, for example, by a misspecified valuation model or behavioral biases (e.g., Hirshleifer (2001)), as sentiment-driven misvaluation. To examine the possibility of insider trading driven by insiders'

desire to exploit investor sentiment, we relate insider trading prior to SEOs and repurchases to a measure of investor sentiment, constructed using the decomposition of Rhodes-Kropf, Robinson, and Viswanathan (2005).

Insider trading prior to repurchases predicts changes in investor sentiment that are similar to those of matched firms with similar characteristics. For SEOs, on the other hand, we find that insider trading predicts changes in investor sentiment that is particular to SEOs: there is no evidence that insider trading predicts changes in sentiment for matched non-SEO firms. The relation between pre-SEO insider trading and changes in investor sentiment is consistent with insiders taking advantage of (upward) biased investor valuations before these are corrected by the market.

The finding of different types of information contained in insider trading prior to SEOs and repurchases is broadly consistent with Constantinides and Grundy (1989) and Bond and Zhong (2016). While neither of the two models examines insider trading prior to corporate events, and neither examines the content of inside information about fundamentals (cash-flow-related information vs. discount-rate-related one), both show that repurchases are more likely to contain information about fundamentals than SEOs. An implication is that insider trading prior to repurchases is more likely to be related to future fundamentals, such as the cost of capital. In contrast, insider trading prior to SEOs is more likely to be related to changes in misvaluation – if one extends the idea of these models to allow for firms to become misvalued (e.g., Baker and Wurgler (2002)). Both of these predictions are borne out in our empirical analysis.

Our final set of tests examines the predictive power of insider trades for announcement returns and long-term abnormal returns following repurchase and SEO announcements. We show that the extent of insiders' net buying prior to repurchases and SEOs strongly predicts the

repurchase and SEO announcement returns. More insider net buying prior to share repurchases (SEOs) is associated with larger positive (smaller negative) announcement returns. A one-standard-deviation increase in pre-event insider net buying is associated with an increase of over 1 percentage point in abnormal returns measured over the three-day period around repurchase announcements. A one-standard-deviation increase in insider net buying is associated with a reduction of around 24 basis points in the magnitude of the negative abnormal returns around SEO announcements. These numbers are substantial relative to the mean announcement returns of 1.9% in the case of repurchases and -2.1% in the case of SEOs.

The market does not immediately absorb all the information in insider trading prior to event announcements. A one-standard-deviation increase in insider net buying before repurchases is associated with an increase of 10 percentage points in one-year abnormal returns after the event. This is significantly higher than the increase of 6 percentage points for matched non-event firms. Similarly, a one-standard-deviation increase in insider net buying before SEOs is associated with a 3-4 percentage point increase in one-year abnormal returns after the announcement, while this relation is not statistically significant for matched non-event firms.

Our paper makes several contributions to the existing literature. Ours is the first paper to examine the *nature* of information contained in insider trades around corporate events. Previous studies show that misvaluation drives both insiders' personal portfolio choices, and their decision to issue new shares. This conclusion is shared by studies that use yearly aggregate data (e.g. Jenter (2005)), and those examining insider trading before equity issues (e.g., Kahle (2000)). Our results suggest that while the direction of insider trading is correlated with fluctuations in misvaluation over time, insider trading prior to repurchases and SEOs is associated not only with changes in misvaluation, but also with future changes in fundamentals – (i) operating

performance and (ii) risk and the resulting cost of capital. To the best of our knowledge, our paper is the first to document the link between insider trading and future fundamentals around repurchases and SEOs. Our empirical results advance the literature on complementarities between the information in event announcements and that in pre-event insider trading (e.g., John and Mishra (1990) and John and Lang (1991)).

Second, our paper contributes to the literature on insider trading patterns around corporate events. Earlier work by Lee, Mikkelson, and Partch (1990) examines insider trading around repurchases during 1977-1988 and finds that insider buying intensifies before fixed price repurchase offers, but not Dutch auction offers. Chan, Ikenberry, Lee, and Wang (2012) study the period 1990-2010 and show that insider trading does not contain incremental information for repurchases in general, only for undervalued (low B/M) firms. For SEOs, Clarke, Dunbar, and Kahle (2001) show that insider selling increases before SEO announcements, and focus on differences between insider selling patterns in completed versus cancelled SEOs. Kahle (2000) and Karpoff and Lee (1991), show that insider sales increase and purchases decrease before equity issuances. We extend this work by comparing repurchases and SEOs using a significantly larger and more recent sample, and documenting changes in insider trading over time.

Our third contribution is generalizing existing studies that examine the relation between insider trading prior to corporate event announcements and short-term and longer-term market reaction to these events. Existing papers tend to concentrate on one of the two sides of insider trading activity – either insider sales or purchases (e.g., Babenko, Tserlukevich, and Vedrashko (2012) and Karpoff and Lee (1991)). Two exceptions are Lee (1997) and Kahle (2000), who examine insider sales and purchases prior to equity and debt issues, but find limited evidence that insider trading is related to announcement returns.

More broadly, these results contribute to the literature that examines complementarities and substitution in information in corporate finance (e.g., John and Mishra (1990), John and Lang (1991), and Buffa and Nicodano (2008)). Most related to our paper, the "joint signal" theory of John and Mishra (1990) argues that pre-event insider trading can provide an additional signal to the market, which can affect the credibility of the signal contained in event announcements.[5] This signal is expected to be stronger if insiders' pre-announcement actions are consistent with the announced corporate action. In other words, if there are complementarities between the information in insider trades and that in corporate actions then we would expect the market reaction to event announcements to depend on pre-announcement insider trading. On the other hand, in the absence of complementarities between the information contained in event announcements and that in pre-event insider trading, we would expect the market to react to insider trading when the information about insider trades is disclosed,[6] and we would not expect an association between insider trading and event announcement returns. Our results show that insider buying before repurchases and SEOs leads to higher event announcement returns, consistent with the complementarity between the two pieces of information. This particular evidence extends the results in Babenko, Tserlukevich, and Vedrashko (2012), who show this complementarity for repurchases only.[7]

Overall, our findings suggest that corporate insiders' personal investment decisions tend to be consistent with their firms' actions: Insiders sell more on average prior to SEOs and they

[5] In contrast, Fried (2005) considers a case of *false* signaling where managers announce repurchases to push up the stock price and sell their own shares, but do not intend to complete the repurchase program.

[6] See Lakonishok and Lee (2001), Jenter (2005), Ravina and Sapienza (2010), and Cohen, Malloy, and Pomorski (2012) for evidence on the informativeness of insider trading.

7 John and Lang (1991) examine the relation between insider trading and another payout method – dividends. In Buffa and Nicodano (2008), share repurchases act as a substitute device for signaling insiders' information when insider trading is forbidden. Our results show that while this substitution between information content in repurchases and insider trading is possible, complementarity between the two seems to be stronger than substitutability.

sell less on average prior to open market repurchases. The information that insiders trade on prior to corporate events seems to be about future changes in operating performance, changes in firm-specific misvaluation, and, in the case of repurchases, about future changes in the cost of capital. Investors seem to incorporate the information in insider trading prior to corporate events when forming reactions to event announcements. The market incorporates the information in pre-event insider trading more rapidly for SEOs than it does in the case of repurchases.

1. Sample and descriptive statistics

We obtain information on open market repurchases and SEOs from SDC Platinum for the period 1986-2017. Regulated utilities (SIC codes 4900–4949) and financial institutions (SIC codes in the 6000 range) are excluded from the sample, as firms in these industries are subject to regulation that can impact their financial policies. We collect accounting and stock price information from the WRDS merged CRSP/Compustat database, and insider trading data from Thomson Reuters. We include events for which we have two years of stock return data available in CRSP prior to the event – we require two years or return data for our tests of changes in the cost of capital. Our final sample contains 4,920 repurchases and 2,069 SEOs. We lose some observations due to missing data in some of our tests. Several tests require data for up to three years following events, therefore these tests cover observations until 2014, 2015, or 2016. We retain observations in the sample as long as they are included in at least one of our empirical specifications. Table 1 reports selected summary statistics of repurchases and SEOs and of the firms performing them. We provide detailed variable definitions in the Appendix.

The average repurchasing firm has $3,520 million ($4,224 million) in book assets (equity market capitalization), while SEO firms are smaller, with mean book assets (market

capitalization) of $2,081 million ($1,657 million). The mean equity M/B ratio of repurchasing firms, computed as in Davis, Fama, and French (2000), is 2.97, considerably lower than that of the average SEO firm, 3.44. The median values are lower for both repurchasing firms and SEO firms (2.32 and 2.46, respectively). Repurchasing firms have higher return on assets (ROA) than SEO firms: 0.157 and 0.102, respectively. The average stock returns of repurchasing firms are negative in the 6 months preceding the repurchase announcement, while firms issuing seasoned equity experience considerable stock price appreciation in the six months preceding SEO announcement. This is consistent with the literature on repurchases (e.g., Kahle (2002), Ben-Rephael, Oded, and Wohl (2014)) and on SEOs (e.g., Billett, Flannery, Garfinkel (2011), Kim and Purnanandam (2014)). The average (median) proportion of shares sought in a repurchase is 7.52% (5.93%), comparable to the figures reported by Grullon and Michaely (2004). The size of the average (median) SEO is 29.47% (20.46%) of the firm's existing shares. The market value of the average (median) repurchase program is $22.47 million ($4.26 million), while the mean (median) value of shares issued in an SEO is $181.1 million ($93.80 million).

We use two measures of insider trading prior to repurchase/SEO announcements. Before calculating them, we use the algorithm of Cohen, Malloy, and Pomorski (2012) to identify "routine" trades, which we discard from the sample.[8] Both measures are based on insider trading in the six months before the event.[9] Our choice of a six-month horizon is motivated by the SEC's short-swing trading rule (15 U.S.C. § 78p(b)). The rule states that profits from round-trip trades (a purchase followed by a sale or vice-versa) in which the two transactions are less than six

[8] The algorithm uses an insider's past trading history: a trade is deemed routine if it follows a schedule of trading in the same calendar month in several consecutive years – 3 years in the main analysis of their paper. In the 6 months before repurchases (SEOs) 23% (30%) of purchases and 23% (37%) of sales are routine.

[9] Firms may disallow insider trading during certain periods (blackout periods), but this is not required by law. Bettis, Coles, and Lemmon (2000) conduct a survey among firms in 1996, and report that the majority of respondents, 78%, place some restriction on insider trading. The most common policy is to allow insiders to trade only in the 12 trading days following earnings announcements. We measure insider trading over a six-month period to ensure that it is not affected by differences in insider-trading restrictions across firms.

months apart, must be returned by the insider to the firm. Firms and insiders are well aware of this rule: Cziraki and Gider (2019) use a bunching design to document a significant increase in round-trip trades that are closed just after six months – allowing the insider to retain the profits.

The first measure, net buy count, is based on Lakonishok and Lee (2001) and is defined as the ratio of the net number of insider purchase transactions in the six months prior to a repurchase/SEO announcement to the total number of insider transactions during that period, $\frac{number\ of\ purchases - number\ of\ sales}{number\ of\ purchases + number\ of\ sales}$. This measure ranges between -1, if all insider trades are purchases in the six months prior to the event announcement, to 1, if all insider trades are sales. The second measure, net buy volume, is defined as the ratio of the net number of shares bought by insiders in the six months prior to a repurchase/SEO announcement, to the total number of shares purchased and sold during that period, $\frac{number\ of\ shares\ purchased - number\ of\ shares\ sold}{number\ of\ shares\ purchased + number\ of\ shares\ sold}$.[10] The average net buy count (net buy volume) measured during the six-month period prior to repurchases (ending the month before the event) equals -0.51 (-0.56); and prior to SEOs, the respective averages are -0.52 and -0.58, implying that SEOs are preceded by slightly heavier insider net selling than repurchases.

Finally, Table 2 shows univariate tests of the outcome variables used in the next sections, splitting the sample into quintiles of net buy count and net buy volume. Higher net insider buying is associated with significantly higher announcement returns (BHAR(-1,1)) and long-term returns (BHAR(2,254)), as well as significantly smaller reductions in ROA, and more positive changes in investor sentiment. For repurchases, higher insider net buying also predicts

[10] The advantages of using these scaled measures are their distributional properties and ease of interpretation. Looking both at trade counts and the number of shares traded renders our analyses more robust. A drawback of these scaled measures is their lack of precision in cases when all trades are in the same direction. For example, net buy count equals -1 if insiders place 1 sale and no purchases, but also if insiders place 100 sales and no purchases. Using unscaled measures such as the raw net buy count (i.e., purchases – sales) alleviates this concern, but at the expense of producing more outliers and making the interpretation more difficult.

larger reductions in the cost of capital. Higher insider net buying predicts significantly larger declines in market beta and in size beta. The pattern is similar for valuation beta but it is not statistically significant. To assess the economic significance of the changes, we use an indicator for whether the decline is larger than the pre-repurchase cross-sectional standard deviation in the cost of capital (6.02), market beta (0.569), size beta (0.763), and valuation beta (0.880). Our findings remain similar: repurchasing firms with higher pre-event insider net buying are significantly more likely to experience an economically meaningful reduction in the cost of capital after the repurchase, through reductions in their market beta and size beta.

2. Insider trading around repurchases and SEOs

We begin the analysis by examining whether there is abnormal insider trading prior to repurchase and SEO announcements. Figure 1 depicts event-time monthly averages of net buy volume in the months around SEO and repurchase announcements for event firms, as well as for matched non-event firms. Months are numbered relative to the month of the event. We split the month of the event into two parts: before and after the event, denoted as "0 before" and "0 after." The length of these two parts is not constant across observations, because firms can announce repurchases or SEOs any day of the month.

Prior to both repurchases and SEOs, we find that, on average, insiders trade the firm's stock in the direction that is consistent with the corporate action. That is, we find that insiders tend to purchase more (sell less) shares prior to repurchases, while they tend to sell more (purchase less) shares prior to SEOs. These results are consistent with the hypothesis that both insider trading and the corporate event (repurchase or SEO) are driven by managers' views on the overvaluation or undervaluation of their firm's stock. An alternative hypothesis, according to

which insiders buy shares in their firms when the latter have profitable investment opportunities unrecognized by the market, is not supported by the data, as this hypothesis would imply abnormal insider buying prior to SEOs. We find no patterns in insider trading at non-event firms.

As we discuss below, insiders' views on misvaluation of their firms' shares may represent insiders' superior projections of firms' future operating performance and risk, and/or insiders' recognition of pricing errors made by the market. For both examined events, the changes in insider trading begin at roughly six months prior to the event, consistent with our rationale for choosing the six-month horizon for the measures we use in the regressions.[11]

To ensure that our results on abnormal insider trading prior to corporate event announcements are not driven by extreme observations, in Figure 2 we examine the percentage of firms that have positive net buy volume around event announcements. Figure 2 shows that not only the average, but the entire distribution of insider trading shifts towards more purchasing prior to repurchases, and towards more selling prior to SEOs. We find very similar patterns in both graphs if we use net buy count instead of net buy volume – these results are available upon request.

Our main goal is to examine whether insider trades prior to corporate events contain additional information beyond that conveyed in the event announcement. However, several studies suggest that absence of insider trading may also contain information. There are two underlying reasons. First, insiders may have mandatory ownership requirements, so once the minimum requirement binds, they cannot sell more shares, although they would do so in an unconstrained setting (e.g., Marin and Olivier (2008)). Second, insiders who possess negative information about the firm may refrain from selling due to litigation risk (e.g., Brochet (2010),

[11] Note that Figures 1 and 2 show these insider trading measures at the monthly level, while the insider trading measures presented in Table 1 and used in our regressions are for the six-month period before events. The six-month net buy volume measures need not equal the simple average of the monthly measures.

Gao and Ma (2012)). To investigate whether insiders abstain from trading in anticipation of event announcements, we examine the likelihood that insiders place no trades at all around corporate events. In Figure 3, we plot the percentage of firms whose insiders place at least one open market transaction during the months before and after repurchases or SEOs.

For both events, we find that the percentage of firms whose insiders trade increases or stays constant in the months preceding a repurchase or SEO announcement. In the case of repurchases, there is no visible difference in the percentage of firms whose insiders place at least one trade in the months immediately preceding repurchase announcements, and other months. For SEOs, 20%-25% of firms have some insider trading in any given month outside of the months prior to event announcement; this figure rises to 26%-30% in the six months prior to the SEO announcement. It is very rare that insiders do not trade in any of the six months preceding our corporate events: this happens in only 3.09% (3.11%) of firms in the repurchase (SEO) sample (not reported in the figure). Thus, insider trading activity does not decline prior to repurchases and it actually intensifies prior to SEOs. These findings are consistent with the view that insiders capitalize on their private information both through corporate actions and through their trading activities prior to corporate event announcements. Our results complement the evidence in Marin and Olivier (2008) and Gao and Ma (2012) by showing that while the incidence of insider trading declines before stock price crashes or acquisition announcements, this is not the case for repurchases or SEOs.

3. What types of information does insider trading convey to the market?

Our objective is to examine the information content of insider trading prior to repurchases and SEOs. Insiders may have superior information about firms' fundamentals, such as future

operating performance and/or cost of capital (e.g., Grullon and Michaely (2004), Ke, Huddart, and Petroni (2003), and Core et al., (2006)). Insiders may also have information about investor sentiment, i.e. the misvaluation of the firm relative to fundamentals (e.g., Piotroski and Roulstone (2005)). In what follows, we examine whether insider trading before corporate events predicts changes in operating performance (Subsection 3.1.), cost of capital (Subsection 3.2.), and investor sentiment (Subsection 3.3.)

In addition to examining whether insider trading predicts future fundamentals and sentiment, we also seek to understand whether any relation we find is particular to insider trading before corporate events. Therefore, we also compare the relations between insider trading on one hand and post-event changes in fundamentals and sentiment on the other hand for repurchasing and SEO firms to that for comparable firms that do not repurchase shares or issue seasoned equity.

Using a propensity score (PS) matching procedure, we match firms announcing events (repurchases and SEOs) to a control sample of firms that do not conduct a repurchase or SEO during a given time period, but have the same level of insider trading. We match each event firm-month observation to a non-event firm-month along four dimensions: size (market capitalization), book-to-market ratio (B/M), past stock returns, and past insider trading. We measure past stock returns over the six-month period before the event (e.g., Jegadeesh and Titman (1993)). B/M is measured during the fiscal year preceding the event. Past insider trading is measured using either the net buy count calculated for the six-month period prior to the event announcement (matching on net buy volume yields similar results). Firms that announce a repurchase or SEO cannot be a part of the control sample for three years: the year before, the year of, and the year after the event.

3.1. Changes in operating performance

We first examine whether insider trading prior to repurchases and SEOs is informative about firms' subsequent operating performance, measured by post-event changes in ROA. To ensure that our results are comparable with those in the literature, we adopt the framework of Grullon and Michaely (2004). Specifically, we examine the change in ROA one to three years following repurchases and SEOs using two specifications. First, using the sample of repurchases, and, separately, SEOs, we estimate equation (1), a linear regression of the change in ROA on each of our two measures of pre-event insider trading. Second, using the pooled sample of event (repurchase/SEO) and matched firms, we also estimate equation (2), allowing a separate coefficient of insider trading for event firms and matched firms:

$$\Delta ROA(t_1,t_2) = \alpha + \beta \times Itr + \delta' \times \textbf{\textit{Controls}} + \varepsilon \quad (1)$$

$$\Delta ROA(t_1,t_2) = \alpha + \gamma_1 \times Itr + \gamma_2 \times Event + \gamma_3 \times Event \times Itr + \delta' \times \textbf{\textit{Controls}} + \eta \quad (2)$$

We use t_1 to denote the year of repurchase/SEO, and t_2 equals either one or three years after the event. *Event* is an indicator variable equaling 1 for events and 0 for matched non-events, and *Itr* denotes our two measures of insider trading. Both regressions further control for firm size (measured as the natural logarithm of total assets), B/M ratio, and past 6-month stock returns to allow for alternative explanations, such as information asymmetry or contrarian trading (e.g., Rozeff and Zaman (1998), Lakonishok and Lee (2001), Jenter (2005), Piotroski and Roulstone (2005)). Table 3 contains the regression estimates.

The results in the first column of Panel A of Table 3 describe the relation between pre-repurchase insider trading and one-year change in ROA, while the results in the second column focus on three-year change in ROA following repurchases. We show the average change in ROA

at the bottom of each column. The ROA of the average repurchasing firm declines in the years following a share repurchase, consistent with Grullon and Michaely (2004). More insider buying (less insider selling) prior to a repurchase is associated with a smaller decline in ROA. The coefficient is not statistically significant at the one-year horizon (columns 1-2), however, it becomes statistically significant at the three-year horizon (columns 5-6). A one-standard-deviation increase in pre-event insider net buying (0.76 from Table 1) is associated with a 0.38 percentage point smaller decrease in ROA three years after repurchases, whereas the average post-repurchase decrease in ROA is 2 percentage points. In columns 3, 4, 7, and 8, we show the results from the interaction specification (equation (2)). These results indicate that insider trading also predicts future changes in ROA at matched non-event firms that have similar characteristics to repurchasing firms.

Panel B shows the results for SEOs. The ROA of the average firm declines in the years after an SEO. These results are consistent with Loughran and Ritter (1997), who find that operating performance deteriorates following SEOs, and with the corresponding prediction of Carlson, Fisher, and Giammarino's (2006) theoretical model. Columns 1, 2, 5, and 6 show that insider net buying is significantly positively related to changes in ROA after SEOs both at the one-year and the three-year horizon. A one-standard-deviation increase in pre-event insider net buying (0.76 net buy count, from Table 1) is associated with a 0.49 percentage point smaller decrease in ROA three years after SEOs, whereas the average change is -2.6 percentage points. As follows from the results in columns 3, 4, 7, and 8, similar to the case of repurchases, insider trading also predicts future changes in operating performance at matched non-event firms with similar characteristics to SEO firms.

Overall, more insider net buying prior to repurchases and SEOs is associated with a smaller reduction in operating performance, as measured by ROA, in the years following repurchase and SEO announcements. These patterns are consistent with our univariate results shown in Table 2. Insider trading is associated with changes in future operating performance at matched non-event firms as well. These patterns are consistent with insider trading prior to repurchases and SEOs being driven, at least in part, by information that insiders possess regarding future operating performance of firms repurchasing or issuing equity.

3.2. Changes in the cost of capital

Insiders may also have knowledge about expected changes in their firms' risk profiles. Hence, we examine whether insider trading prior to repurchases and SEOs is driven by information regarding changes in event firms' risk and the resulting cost of capital. We estimate a Fama-French (1992) three-factor model using monthly data for a window starting 36 months before and ending 36 months after the event (73 months in total). In our estimation, we use indicator variables to allow for different factor exposures before and after the event. We estimate the following model for the repurchase and SEO samples separately:

$$r_{it} - r_{ft} = a_{-i} + a_{\Delta i} D_t + b_{-i}(r_{mt} - r_{ft}) + b_{\Delta i} D_t (r_{mt} - r_{ft}) + s_{-i} SMB_t + s_{\Delta i} D_t SMB_t + h_{-i} HML_t + h_{\Delta i} D_t HML_t + e_{t,} \quad (3)$$

where r_{it} is the return on stock i, r_{ft} is the return on one-month U.S. Treasury bill, r_{mt} is the return on the value-weighted market index, SMB_t and HML_t are the returns on Fama-French size and book-to-market factor portfolios, and D_t is a dummy variable that equals one if $t \geq t^*$, where t^* is the month of the event. Subscript $-i$ refers to coefficient estimates prior the event, while subscript Δi refers to changes in coefficient estimates following the event. After estimating the

regression in (3) for firms repurchasing and issuing equity, as well as their matched peers, we estimate changes in the cost of capital using changes in factor exposures in (3) and the average factor premia over our estimation period, 1983–2014.[12]

After estimating changes in each firm's cost of capital following repurchases and SEOs, we perform two tests, similar to those in Table 3. First, we regress the change in the total estimated cost of capital on each of our two measures of pre-event insider net buying for event firms. Second, using the pooled sample of event (repurchase/SEO) and matched firms, we also estimate equation (2), using the change in the cost of capital as the dependent variable. We add the same control variables as in Table 3, but, to conserve space, do not report their coefficients.

We summarize the results in Table 4. Columns 1-2 of Table 4 show that repurchasing firms' cost of capital declines by 1.50 percentage points following the repurchase. We find that more insider net buying is associated with a larger decline in the cost of capital. The coefficients are highly statically significant, and the implied economic effects are large. Based on the results in column 1, a one-standard-deviation increase in insider net buying is associated with a 0.30 percentage point larger decline in the cost of capital, which equates to one-fifth of the average decline. Columns 3 and 4 show that insider trading does not predict similar changes in the cost of capital of matched firms that are similar to repurchasing firms. The level coefficients on the insider trading measures are small and not statistically significant. In contrast, the interaction terms of the event dummy and the insider trading measure are larger than those in columns 1 and 2, and remain statistically significant, with higher t-statistics. We conclude that insider trading before repurchases predicts changes in the cost of capital, and that this predictive power of insider trading is particular to event firms.

[12] In particular, for each event and matched non-event, the estimated change in the cost of capital is $\Delta r_{it} = 0.03745 + b_{\Delta i} \times 0.05300 + s_{\Delta i} \times 0.01737 + h_{\Delta i} \times 0.02297$.

Taking the results in Columns 1-4 of Table 4 and those in Panel A of Table 3 together suggests that pre-repurchase insider trading is more strongly associated with post-repurchase changes in the cost of capital than with changes in ROA. This finding supports the hypothesis that firms repurchase shares and insiders buy shares on their own account when there is an anticipation of reduction in firms' risk and cost of capital. This result is consistent with the real options theory, according to which firms' risk is expected to decrease following real options exercise (e.g., Carlson, Fisher and Giammarino (2004, 2006)). It is also consistent with the Q theory of investment, according to which investment rate is expected to be larger following a reduction in the (expected) cost of capital (e.g., Zhang (2005), Li, Livdan and Zhang (2009)). Indeed, we find a 0.6 percentage point increase in the investment rate around the time of share repurchases, which represents an 11% increase relative to the pre-repurchase investment rate.

Columns 5-8 of Table 4 present the results for SEOs. We find no significant association between pre-SEO insider trading and the change in issuing firms' cost of capital. We also find no significant relation between insider trading and future changes in the cost of capital for matched firms whose characteristics are similar to those of SEO firms.

To summarize, the results in Table 4 show that insider net buying prior to repurchases is associated with changes in the cost of capital for firms conducting repurchases, but not for matched firms. This evidence suggests that prior to repurchases insiders may possess private information about upcoming changes in their firms' risk and cost of capital, and that repurchases are particular in this regard. We do not find such evidence for SEOs: There is no relation between insider trading prior to SEOs and subsequent changes in issuing firms' cost of capital.

3.3. Changes in investor sentiment

In this section, we examine whether insider trading before corporate events predicts changes in investor sentiment. The reason for the potential importance of investor sentiment is that even if insiders do not have private information about future changes in fundamentals, they may recognize market mispricing and exploit it at both the personal level (insider trading, e.g., Seyhun (1992), Jenter (2005), and Piotroski and Roulstone (2005)) and at the firm level (repurchases and SEOs). We refer to such mispricing, driven, for example, by a misspecified valuation model or behavioral biases (e.g., Hirshleifer (2001)), as sentiment-driven misvaluation.

Jenter (2005) and Piotroski and Roulstone (2005), among others, show that insiders tend to sell when the valuation of their firm's stock is high and to buy when the valuation is low. Thus, there are periods in which insider trades are more likely to be driven by insiders' desire to exploit mispricing due to investor sentiment, rather than their private information about future cash flows and cost of capital.

To examine whether this is the case, we first calculate a measure of firm-specific sentiment. We follow the market-to-book decomposition of Rhodes-Kropf, Robinson, and Viswanathan (2005) to obtain the firm-specific error component of the market-to-book ratio. It is defined as the residual from the following regression (equation (15) of Rhodes-Kropf et al. (2005, p. 577)):

$$m_{it} = \alpha_{0jt} + \alpha_{1jt}\boldsymbol{b_{it}} + \alpha_{2jt}\ln(\boldsymbol{NI})^{+}_{\boldsymbol{it}} + \alpha_{3jt}I_{(<0)}\ln(\boldsymbol{NI})^{+}_{\boldsymbol{it}} + \alpha_{4jt}LEV_{it} + \varepsilon_{it}, \qquad (4)$$

where m is log market value, b is log book value, NI is net income, $I_{(<0)}$ is an indicator variable for loss-making firms, and LEV is the leverage ratio. Subscript j indexes industries (based on the Fama-French 12 industry classification), i indexes firms, and t refers to time. We estimate this regression for each industry-year.

An advantage of applying the Rhodes-Kropf et al. (2005) decomposition method to measure misvaluation in our setting is that it can be used to separate firm-specific errors in valuation (i.e., firm-specific sentiment) from industry-level time series errors (i.e., industry-level sentiment). This is important because insiders are more likely to have accurate information on the former than on the latter.

Table 5 presents results from regressions of the change in investor sentiment from the year before the event (t-1) to the year after (t+1) on measures of insider net buying. The layout of the table is similar to that of Tables 3 and 4. We add the same control variables as in Table 3, but, to save space, do not report their coefficients. We first examine the repurchase subsample. Columns 1-2 show that more insider net buying before repurchases is associated with an increase in investor sentiment one year after the repurchase relative to one year before. A one-standard-deviation increase in insider net buying is associated with a 2.5% increase in sentiment around the repurchase. Because the sentiment measure of Rhodes-Kropf et al. (2005) is the residual from a regression of log market values, this can be interpreted as an additional 2.5% increase in the market value of the firm that is not explained by fundamentals or by changes in market valuation common across firms in the same industry. The average change in the sentiment measure around repurchases is -0.030, so a one-standard-deviation increase in insider net buying corresponds to a change that is 83% of the average. Note, however, that because our dependent variable is a regression residual, this quantitative interpretation is likely imprecise. Columns 3-4 show that the predictive power of insider trading for changes in sentiment is similar across repurchasing firms and their matched firms in both size and significance.

Columns 5-8 summarize the regression results for SEOs. Columns 5-6 show that insider trading before SEOs is strongly and significantly correlated with the change in investor

sentiment from before the SEO to after it. A one-standard-deviation increase in insider net buying before SEOs is associated with a 3.7% increase in sentiment. The average change in firm-specific sentiment around SEOs is -0.150, implying that a one-standard-deviation increase in insider net buying corresponds to a change that is 25% of the average.

Columns 7-8 compare the predictive power of insider trading for changes in sentiment for SEO firms and their matched peers. First, the coefficient on the event dummy shows that sentiment declines by 7.6% for SEO firms relative to their matched counterparts. Second, insider trading predicts changes in sentiment only for SEO firms, but not for matched firms that do not conduct an SEO. To summarize, on average, sentiment declines around SEOs, both on average, and when we compare SEO firms to similar firms that do not issue shares. However, insider trading prior to SEO is able to predict a large percentage of the change in investor sentiment, and this predictive power is not present at matched firms.

Overall, our results indicate that insider trading prior to repurchases predicts changes in operating performance, in the cost of capital, and in investor sentiment. The predictive power of insider trading for changes in the cost of capital is particular to repurchases and not present at matched firms with similar characteristics. For SEOs, we find that insider trading predicts changes in operating performance, and in investor sentiment. The second result is particular to SEOs: we find no evidence that insider trading predicts changes in sentiment for matched non-SEO firms. These results are consistent with the idea that insiders possess information on future fundamentals as well as sentiment, and also that they are more likely to trade on some of this information around corporate events. The results are also broadly consistent with theoretical models of Constantinides and Grundy (1989) and Bond and Zhong (2016), which suggest that insider trading before repurchases is more likely to contain information on fundamentals,

whereas insider trading before SEOs is more likely to be related to investor misvaluation.

4. Abnormal returns and the complementarity of event announcement and insider trading signals

Given our evidence on the information content of insider trading prior to repurchases and SEOs, we now examine whether insider trading predicts short-term and long-term market reaction to these events. We focus on whether the information contained in insider trading activity prior to the events interacts with the information contained in them. In other words, we are interested in testing whether the signal contained in announcements of repurchases and SEOs on one hand and that contained in pre-event insider trading on the other hand are complementary. We perform two tests. First, we examine event-time buy-and-hold abnormal returns around repurchase and SEO announcements. Second, we use the calendar-time portfolio approach in which we examine risk-adjusted long-term returns of portfolios of firms announcing repurchases and SEOs.

4.1. Event announcements and insider trading: event study results

Insider trading has been shown to be positively related to future returns (e.g., Jenter (2005), Cohen, Malloy and Pomorski (2012)), a finding we confirm in our data for both repurchases and SEOs. However, what we are primarily interested in is whether insider trading has a stronger relation with returns following corporate event announcements than at other times, i.e. whether there are complementarities between information contained in pre-event insider trading and information in event announcements. To examine these complementarities, we compare the relation between insider trading and post-event-announcement returns to that between insider trading and returns of comparable firms that do not repurchase or issue shares.

We thus rely on our sample of matched non-event firms introduced in the previous section in the analysis of announcement and long-term abnormal returns.[13] Using the sample that includes both event firms and matched control firms, we estimate the following regression:

$$BHAR(t_1,t_2) = \beta_0 + \beta_1 Event + \beta_2 Itr + \beta_3 Ret + \beta_4 Event \times Itr + \beta_5 Event \times Ret + \varepsilon. \quad (5)$$

The dependent variable in (5) is the buy-and-hold abnormal return measured over the three days surrounding the event announcement. Because non-events do not effectively have an event date, we assign a random day of the month as the event date. We verify that this closely matches the distribution of both repurchase and SEO announcements, as both appear to be uniformly distributed within months. $BHAR(t_1,t_2)$ is calculated by cumulating daily abnormal returns of either the event or matched firm. We estimate abnormal returns relative to Carhart's (1997) four-factor model. To ensure that our results are not driven by outliers, we winsorize buy-and-hold abnormal returns (BHARs) for both events and non-events at the 5th and the 95th percentiles. Following Lakonishok and Lee (2001), we also include past returns (*Ret*) over the prior six months to disentangle trading on insider information from contrarian trading. We allow the coefficients on insider trading and past returns to vary across events and non-events by including interaction terms between the event dummy and these two variables. Standard errors are clustered at the firm level.

The use of the control sample allows us to isolate the differential effect of the interaction between insiders' trading and corporate events. Thus, we are primarily interested in the coefficient β_4, which captures whether insider trading prior to repurchases and SEOs is related to the informational content of announcements of these events, and whether such announcements

[13] To streamline the analysis, we omit simple regressions of abnormal returns on insider net buying. We find that more insider net buying is associated with higher announcement returns, and higher long-term returns after both repurchases and SEOs. These results are in line with those of prior studies that look separately at insider trading around repurchases, and insider trading around SEOs.

convey a stronger signal for future returns than they do at other times. It is likely that the use of a control sample will be inconsequential in the analysis of short-term market reactions. For long horizons, the comparison to non-events is crucial, as previous work finds evidence that past insider trading is related to future returns in the long term even outside of the context of corporate event announcements (e.g., Lakonishok and Lee (2001)). Hence, we expect that both β_2 and β_4 will be positive and statistically significant.

Table 6 columns 1 and 3 present the results of estimating (5) over the three-day window surrounding event announcements. Column 1 contains the results for repurchases. In line with the literature (e.g., Kahle (2002), Babenko, Tserlukevich, and Vedrashko (2012), and Dittmar and Field (2015)), we find a positive and significant announcement return for repurchases, equaling 1.91%. The coefficient on the event dummy, β_1, is positive and significant, both statistically and economically. Not surprisingly, insider trading is not significantly related to returns of matched firms, as is evident from the coefficients on the level of net buy volume, β_2.

Importantly, our estimates of β_4, the coefficient on the interaction between the repurchase dummy and net buy volume, is statistically significant. A one-standard-deviation increase in insider net purchases is associated with an increase of over 1 percentage point in the difference in abnormal returns measured over the three-day period (-1,1) surrounding the repurchase announcement between event firms and control firms. This effect is quite large, as the average announcement return across our sample of repurchases is 1.91%, as shown at the bottom of Table 6.

Column 3 of Table 6 presents the results of estimating (5) using the SEO sample. Consistent with past studies (e.g., Denis (1994), Kim and Purnanandam (2014)), the average market reaction to SEOs is negative and significant, around -2.1%, in our sample. We find that

insider trading does not have a significant impact on matched firms' returns, as evident from the coefficient on net buy volume. Importantly, however, the coefficient on the interaction between the event dummy and pre-SEO insider trading is positive and significant. The impact of a one-standard-deviation increase in insider trading is associated with an economically sizeable increase of around 24 bps in the difference between the mean announcement returns of SEO firms and that of matched firms.

Taken together, the results in Table 6 columns 1 and 3 imply that abnormal insider trading before the announcement of corporate events conveys information that is complementary to that in event announcements. Events with more insider net buying in the six months prior to the event exhibit significantly more positive market reaction to event announcements than events with less insider net buying. We find similar results if we use net buy count instead.

The information in pre-event insider trading may not be fully incorporated into stock prices by the end of the first trading day following the repurchase or SEO announcement. Therefore, we examine whether the predictive power of insider trading for long-term stock returns is higher following repurchases and SEOs than in the absence of these events. We use the same matched sample approach as before, but now look at the buy-and-hold abnormal returns measured from 2 to 254 trading days (i.e., 12 calendar months) after the event.

Table 6 column 2 presents the long-term return regression results for the repurchases sample. The coefficients on the event dummy show that, on average, repurchases exhibit a buy-and-hold abnormal return that is around 10% higher than the abnormal return of otherwise similar firms that do not conduct a repurchase. Insider trading is positively related to long-term returns for the matched sample (non-repurchasing firms), as evident from the statistically significant coefficients on net buy volume, which is also economically large: A one-standard-

deviation increase in six-month insider net buying is associated with an almost 6 percentage point higher post-event 12-month return.

Importantly, we find evidence consistent with complementarity between insider trading and event announcements: more insider net buying before an open market repurchase announcement is associated with significantly higher abnormal returns in the year following the event, over and above the relation between insider trading and long-term returns at other times. The interaction between net buy volume and the repurchase dummy show that a one-standard-deviation increase in insider net buying during the six months before the event is associated with an increase of around 4 percentage points in abnormal returns during the year following the event over and above the abnormal returns for non-event firms. In other words, the effect of pre-repurchase insider trading on long-term buy-and-hold returns is 67% stronger for repurchasing firms than for control firms.[14]

Table 6 column 4 describes the relation between insider trading and long-term abnormal returns following SEOs. Insider net buying is positively related to long-term returns for both SEO firms and control firms, but the coefficient is relatively small, and not statistically significant. However, the coefficient of the interaction term between insider trading and the event dummy is positive and significant. A one-standard-deviation decrease in pre-SEO six-month insider net buying is associated with a 4 percentage point reduction in post-SEO 12-month returns for event firms.

In sum, the results in Tables 6 indicate that insider net buying prior to repurchases and SEOs is positively related to post-event returns, and this relation is significantly stronger

[14] Bargeron, Bonaimé, and Thomas (2016) suggest that long-run returns following share buyback announcements are driven by takeover activity or takeover risk. Only 1.97% of our repurchasing firms (and 2.35% of their matched peer firms) become acquisition targets within the one-year period after the announcement day. Controling for whether the firm is acquired during this period, or discarding observations of firms that are acquired does not change the results in Table 6.

compared to matched firms that do not issue or repurchase equity. Further, pre-event insider trading is positively and significantly related to both announcement returns and to long-term post-announcement returns, indicating that the market does not immediately incorporate the information in pre-event insider trading into firms' stock prices.[15]

4.2. Calendar-time portfolios using information on insider trading and corporate events

Since tests of abnormal performance using buy-and-hold abnormal returns may over-reject the null hypothesis due to skewness of the distribution of test statistics (e.g., Barber and Lyon (1997), Kothari and Warner (1997)), or due to the correlation between abnormal return observations of the same firm (e.g., Mitchell and Stafford (2000)), we also measure abnormal returns using calendar-time portfolios (Fama (1998) and Mitchell and Stafford (2000)). In our setting, the calendar-time portfolio approach is expected to yield a conservative estimate of returns to a strategy based on insider trading information.

To form portfolios, we use the following rule: the high insider buying portfolio for repurchases (SEOs) contains shares of firms that announced a repurchase (SEO) in the past *k* months and have a net purchase ratio of 1 (i.e., all insider trading in the six-month period before the event was buying). Similarly, the low insider buying portfolio for repurchases (SEOs) contains shares of firms that announced a repurchase (SEO) in the past *k* months and have a net purchase ratio of –1 (i.e., all insider trading in the six months before the event was selling).[16]

[15] To verify that our measure indeed reflects the trading of insiders who can influence corporate decisions, we re-calculate our net buy volume measure based only on trades placed by the top tier of corporate insiders, including the CEO, CFO, COO, chairman of the board, and president. We find that the correlation between the measure based only on the trades of these top insiders and our original measure is 0.85 for repurchases and 0.83 for SEOs, both significant at the 1% level. As expected, our results in Tables 6 and 7 remain similar if we include a dummy variable in the regression indicating whether any of these top-level insiders trade in the six months leading up to the event, and interact this dummy with our slope coefficients.

[16] The 20th percentile of net buy count is –1, whereas the 80th percentile is 0.89 over our entire sample period. Hence, ex post, our portfolio rule can be thought of as one that is close to forming quintile portfolios. However, ex

Finally, we construct a self-financing portfolio that is long in high insider buying stocks and short in low insider buying stocks for repurchases (SEOs). Using the same rule, we construct similar high insider buying, low insider buying, and long-short portfolios for the matched control samples. We examine returns for holding periods of k = 3, 6, and 12 months, for both equally-weighted and value-weighted portfolios. We estimate portfolio alphas using Carhart's (1997) four-factor model. We summarize the results in Table 7.

Our calendar-time portfolios that use insider trading information to invest in firms that announce repurchases in the past three months generate alphas of 0.70% (low insider net buying) and 1.80% (high insider net buying) per month. The long-short portfolio earns an alpha of 1.10% per month, significant at the 5% level. In contrast, the same investment strategy within our control sample leads to alphas that are insignificant both statistically and economically: The alpha of the long-short portfolio for the control sample is -59 bps. Finally, the difference between the two long-short portfolio alphas (repurchases vs. control) is a statistically significant 1.69% per month. We find similar results for longer holding periods. The long-short portfolio using a holding period of 6 (12) months for repurchases generates a statistically significant alpha of 0.99% (0.87%) per month, while the same strategy for the control sample generates a statistically insignificant alpha of -0.38% (0.56). Using a holding period of 6 (12) months, the difference between the alphas of the long-short portfolios for repurchases versus control firms is a statistically significant (not statistically significant) 1.37% (0.31%) per month.[17]

ante, investors do not know the exact percentiles of the distribution during the entire sample period. Also, using the values of 1 and –1 is intuitive as it implies that investors trade only in instances in which all insider trades are made in the same direction (buy or sell). This criterion has been used in the context of insider trading by Jenter (2005).

[17] The patterns are weaker for value-weighted portfolios. At the 6-month and 12-month horizons, we find alphas of 0.42% and 0.53% for the long-short portfolios in the repurchase sample. In contrast, alphas for the long-short portfolios in the control sample are small and statistically insignificant. Therefore, even among repurchasing firms, the result that insider trading predicts long-term returns is primarily due to small stocks.

Overall, a portfolio strategy that uses pre-event insider trading information earns positive returns following repurchases, and these alphas are statistically and economically significant for equally-weighted portfolios. The same strategy does not earn significant positive alphas in a sample of control firms with similar characteristics to repurchasing firms. These results, coupled with our earlier analysis of abnormal returns, suggest that insider trading predicts future returns around repurchases more than it does at other times. This finding is consistent with the interpretation that the information contained in the repurchase announcement and the information contained in pre-event insider trades are complementary.

For SEOs, we do not find significant alphas for the long-short portfolios based on insider trading information. In all cases, the alphas are larger in the SEO sample than in the control sample. Hence, the calendar-time portfolio approach yields a different conclusion than our event study analysis within the SEO sample. Thus, our point estimates suggest that insider trading around SEOs predicts future long-term returns more than it does at other times, but this relation is noisy and, depending on the empirical method used, may lack statistical significance.

5. Time variation in the predictive power of insider trades

Our sample extends over three decades that have seen significant changes in financial markets including changes in regulation, the emergence of high frequency trading, changing trends in payout policy, as well as market booms and crashes. We, therefore, examine whether the main results change over time.[18]

5.1. Firm-level insider trading restrictions and time variation in the incidence of insider trading

In recent years, firms have voluntarily adopted insider trading restrictions (e.g., Betties, Coles

[18] We are grateful to two anonymous referees for suggesting this line of inquiry.

and Lemmon (2000), Lee, Lemmon, Li and Sequeira (2014)). We therefore check whether the patterns documented in Figure 3 still hold in the later part of our sample. Figure 4 splits our sample into four periods of approximately eight years each, and graphs the incidence of insider trading around repurchases and SEOs separately during these periods. There are three noticeable changes over time. First, the level of insider trading does not decline over time. There is a slight decline in the incidence of trading before repurchases from the period 1986-1993 to 1994-2001, but then the likelihood of pre-repurchase trading increases again and is the highest during the 2010-2017 period. Second, the graphs generally do not slope down before either of our events, indicating that despite firm-specific policies, insider trading does not decrease before events. If anything, insider trading intensifies before SEOs for all four subperiods. Third, insider trading becomes more cyclical during the second half of our sample. The peaks and troughs for repurchasing firms suggest that blackout windows scheduled before quarterly earnings announcements, or vesting schedules of option and restricted stock grants do indeed affect insiders' trading behavior.[19]

5.2. Time variation in the predictive power of insider trades

Next, we examine whether the relations we document between insider trading and future fundamentals, sentiment, and stock returns are specific to any part of our sample period. To do so, we re-estimate selected models from Tables 3-7 separately each calendar year. To be consistent, we focus on the coefficients on *Net buy volume* or *Event* × *Net buy volume* – depending on the outcome variable – that we interpreted when discussing our main results. Figure 5 graphs these coefficient estimates over time.

[19] These cycles are pronounced at repurchasing firms, which are significantly larger than SEO firms, and, therefore, are more likely to offer stock-based compensation plans, and to have a dispersed ownership base necessitating stricter corporate governance standards – including restrictions on insider trading (e.g., Lee et al (2014)).

5.2.1. Changes to the reporting and monitoring of insider trades

The Sarbanes-Oxley Act (SOX), which came into force on August 29, 2002, changed the regulation and enforcement of insider trading significantly. Before SOX, insiders were required to report their trades by the 10th day of the month following the trade. SOX required insiders to report their trades within two business days. Further, insiders' compliance with the insider-trading regulations was also monitored more closely following SOX (e.g., Brochet (2010), Betzer et al. (2015)). One may, therefore, expect insider trading to be less informative about future fundamentals, sentiment, and stock returns following 2002. However, we find no evidence of this looking at the time-series of coefficient estimates in Figure 4. We also formally test whether the coefficient estimates plotted in Figure 4 are smaller in absolute value after SOX and find that this is not the case for any of the coefficients (the results of these tests are available upon request).

5.2.2. High-frequency trading

The emergence of high-frequency trading (HFT) is another important change that took place during our sample (e.g., Menkveld (2015)). Empirical studies suggest that HFTs are not only fast, but are also informed (e.g., Hasbrouck and Saar (2013), Brogaard, Hendershott, and Riordan (2019)) – perhaps because of their ability to quickly parse public information such as macro announcements (e.g., Hu, Pan, and Wang (2014)), or message traffic on the exchange (e.g., Harris and Saad (2014)). While in 2000, HFTs accounted for less than 10% of equity trading, by 2010 their share was estimated at over 50%. If HFTs render prices more informative, one may expect insider trading to become less informative over time. There is no evident pattern of

attenuation in the coefficient estimates in Figure 4, suggesting that, to the extent that HFT is information based, corporate insiders and HFT trade on different pieces of information. In unreported analyses, we test for a time trend in the estimates by adding a time variable to our regressions and interacting it with the coefficients. These tests suggest that there is no significant time trend in annual coefficient estimates.

5.2.3. Changes in corporate payout policy

Firms have shifted their payout policy from dividends to repurchases over the last decades (e.g. Grullon and Michaely (2002), Farre-Mensa, Michaely, and Schmalz (2014) Michaely and Moin (2017)). Theoretically, dividends are the more sticky form of payout, whereas repurchases are more flexible. However, with repurchases gaining prominence over time, they may have become more predictable and may, therefore, contain less information. Accordingly, the information contained in insider trading before repurchases may also have declined over time.

We examine this hypothesis in three ways. First, given the aggregate trend of repurchases gaining prominence, we should see the absolute value of regression coefficients declining over time. However, as we discuss above, there is no significant time trend in annual coefficient estimates. Second, at the individual firm-year level, we define a firm as substituting dividends with repurchases if its dividends decrease from the previous year while its repurchases increase. Third, in an alternative definition of substitution, we consider firms for which the ratio of repurchases to total payouts (repurchases plus dividends) increases by more than 10% from one year to the next. We then examine whether insider trading becomes a less accurate predictor of fundamentals, sentiment, and returns when repurchases become more prominent. We find no difference in coefficient estimates using either of our two definitions of substitution (the results

are available upon request). On the whole, we do not find patterns that would suggest that changes in payout choices have affected the predictive power of pre-event insider trading over time.

5.2.4. Stock market booms and downturns

Finally, our sample period has also seen a number of stock market booms and reversals. It is possible that insiders trade differently during crisis periods (e.g., Marin and Olivier (2008)), or that they underreact or overreact to certain market conditions (e.g., Seyhun (1990)), so that the predictive power of their trades is confined to upturns (or downturns). If this is the case, then our coefficient estimates should be correlated with stock market cycles. We find no consistent evidence of such correlations in Figure 4. For example, higher insider net buying consistently predicts lower cost of capital (matching the prediction from our baseline estimate) in each of the years 2007-2010, a period that contains both the recent financial crisis, and part of the subsequent recovery. Similarly, insider trading before SEOs is a poor predictor of three-year-ahead ROA during 2005-2009, but does well in the down market after the dotcom bubble 2001-2002, as well as in the post-crisis recovery years of 2010-2011. We formally test whether coefficient estimates are different in upturns and downturns using two monthly measures: (i) the NBER recession indicator and (ii) an indicator that equals one if the return on the market portfolio is negative.[20] We find no consistent evidence of a significant difference in our estimates in up versus down markets. For example, in the regression of changes in the cost of capital after repurchases, the coefficient of *Event* × *Net buy count* equals -0.52 in up markets and -1.14 in down markets, with the difference being statistically insignificant. In the regression of changes in

[20] The NBER recession indicator is available from the Federal Reserve Bank of St. Louis at https://fred.stlouisfed.org/series/USREC (last accessed on July 9, 2019). To calculate the return on the market portfolio, we use the definition provided in Fama and French (1993).

sentiment around SEOs, the coefficient of *Event* × *Net buy count* equals 0.064 in up markets and 0.069 in down markets, the difference being insignificant as well (these tests are untabulated). These results suggest that corporate insiders tend to trade on information that is specific to their firm, rather than to the market as a whole.

We conclude that while there have been significant shifts in the regulation of insider trading, in the organization of financial markets, and in stock market cycles during our sample period, our findings are not confined to one particular regime. Insider trades contain information about firm fundamentals, which is valuable in both upturns and downturns.

6. Conclusions

We use a comprehensive sample of over 3,900 share repurchase and over 1,600 SEO announcements made between 1986-2017 to examine the information contained in insider trades prior to repurchases and SEOs. While prior studies show that insiders refrain from trading before other corporate events, such as mergers and acquisitions or releases of adverse news, we show that this is not the case for repurchases and SEOs. If anything, insiders are more likely to trade before repurchases and SEOs than at other times. Moreover, insiders tend to trade in the direction of the upcoming corporate event: There is an abnormally high insider net buying activity prior to repurchases and abnormally low insider net buying activity prior to SEOs.

Consistent with the real options theory and the Q-theory of investment, we find that pre-event insider trading contains information regarding future changes in the cost of capital for repurchasing firms, while there is no such relation for otherwise similar firms that do not conduct a repurchase. Consistent with signaling models of SEOs, we find that insider trading predicts changes in investor sentiment around SEOs that are specific to event firms: we find no evidence of changes in sentiment for matched firms.

Our paper sheds new light on the relation between insider trading around corporate events and firms' future returns and fundamentals. We find that more insider net buying prior to repurchases and SEOs is associated with higher announcement returns and higher post-event long-term returns. The relation between insider trading and returns is stronger around these corporate events than during other periods, suggesting that the information contained in pre-event insider trading and that in event announcements are complementary. Finally, our findings are robust over time: The main results hold across various regulatory regimes and market conditions, and extend to the more recent period characterized by an increase in market participation by high-frequency traders.

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Appendix: Variable definitions

Variable	Definition
Total assets	Total assets. Source: Compustat
Market capitalization	Number of shares outstanding multiplied by the end-of-year stock price. Source: Compustat
M/B	Market-to-book ratio calculated as market capitalization divided by book equity. Book equity is calculated as in Davis, Fama, and French (2000): the book value of stockholders' equity, plus balance sheet deferred taxes and investment tax credit (if available), minus the book value of preferred stock. Source: Compustat
ROA	Return on assets calculated as operating income before depreciation (EBITDA) scaled by the average of beginning- and ending-period book value of assets. Source: Compustat
Ret6	Stock return over the six months prior to the month of the event (months (*t*-6) to (*t*-1), where *t* is the month of the event). Source: CRSP
Ret12	Stock return over the 12 months prior to the month of the event (months (*t*-12) to (*t*-1), where *t* is the month of the event). Source: CRSP
% sought	The number of shares authorized for repurchase divided by the number of shares outstanding at the time of the announcement. Sources: SDC and Compustat
Offer size (%)	The number of shares offered in the SEO divided by the number of shares outstanding at the time of the announcement. Sources: SDC and Compustat
Value	For repurchases, it is the total market value of the repurchase program. For SEOs, it is the total market value of the shares sold in the equity offer. Source: SDC
Net buy count	The net number of purchases scaled by the total number of open market insider transactions: (number of purchases - number of sales)/(number of purchases + number of sales). The variable is measured over the six months prior to the month of the event (months (t-6) to (t-1), where *t* is the month of the event) in Table 1 and all of the regressions, and in each month in Figures 1 and 2. Source: Thomson Reuters
Net buy volume	The net volume of shares purchased scaled by the total number of shares purchased or sold in open market insider transactions: (number of shares purchased - number of shares sold)/(number of shares purchased + number of shares sold). The variable is measured over the six months prior to the month of the event (months (*t*-6) to (*t*-1), where t is the month of the event) in Table 1 and all of the regressions, and in each month in Figures 1 and 2. Source: Thomson Reuters
Event	Binary variable equal to 1 for event (repurchase or SEO) observations and equal to 0 for placebo observations. Source: SDC
Sentiment	Investor sentiment is measured as the firm-specific component from the market-to-book decomposition of Rhodes-Kropf, Robinson, and Viswanathan (2005).. Source: Compustat

Figure 1. Insider net buying around repurchases and SEOs

Data on insider trading are from Thomson Reuters. The figure shows monthly averages of *net buy volume*, defined as (number of shares purchased – number of shares sold)/(number of shares purchased + number of shares sold). The series for event firms are plotted with solid lines and filled markers. The series for matched non-event firms are plotted with dashed lines and empty markers. The lines marked with triangles show insider trading measures around repurchases (and matched non-events), and the lines marked with circles show insider trading measures around SEOs (and matched non-events). The data are shown in event time. "0 before" refers to the part of the month of the event prior to the event, and "0 after" refers to the part of the month of the event after the event.

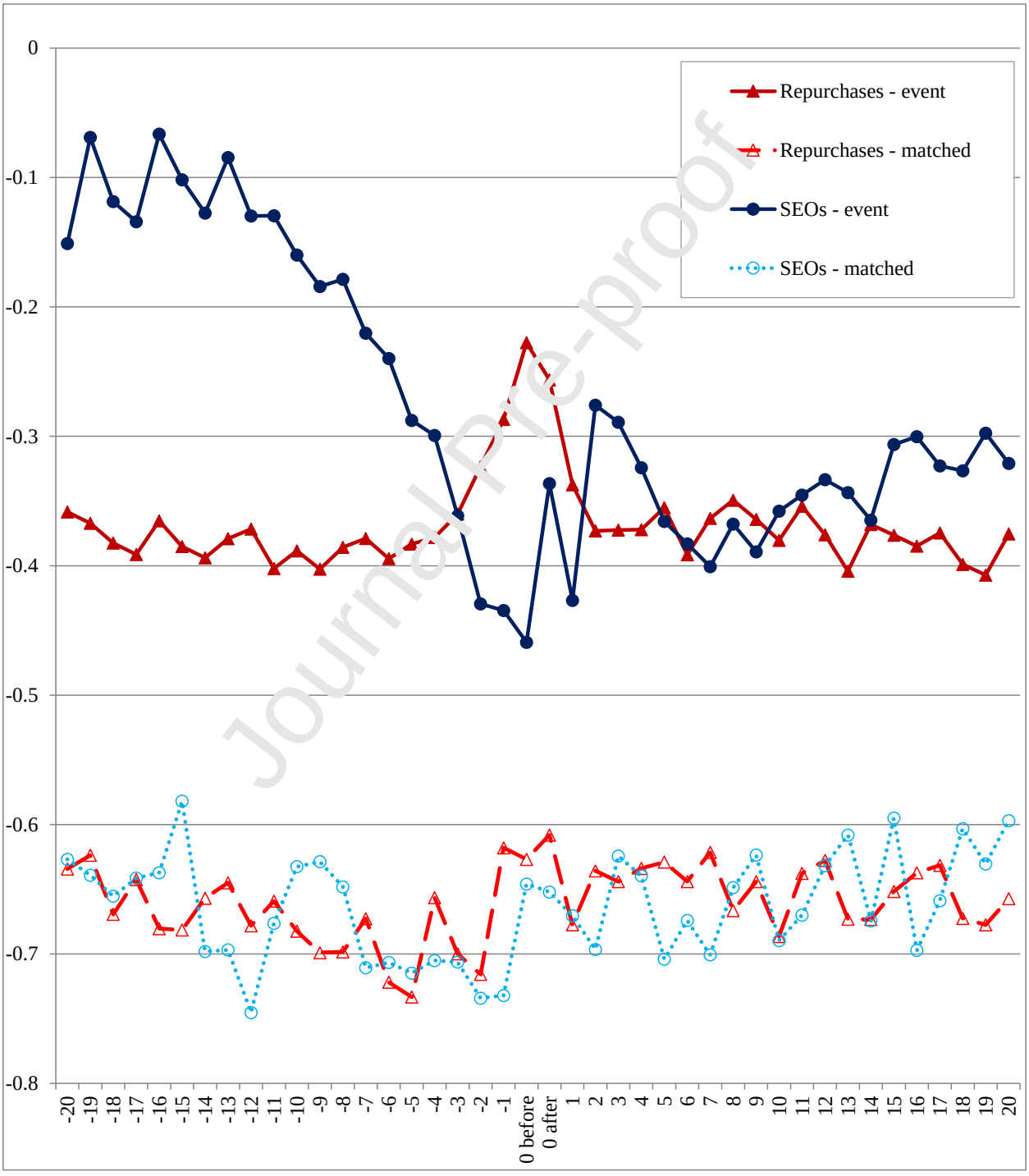

Figure 2. Percentage of firms with positive insider net buying around repurchases and SEOs

Data on insider trading are from Thomson Reuters. The figure shows the percentage of firms with positive net insider buying using *net buy volume*, defined as (number of shares purchased – shares sold)/(number of shares purchased + shares sold The series for event firms are plotted with solid lines and filled markers. The series for matched non-event firms are plotted with dashed lines and empty markers. The lines marked with triangles show insider trading measures around repurchases (and matched non-events), and the lines marked with circles show insider trading measures around SEOs (and matched non-events). The data are shown in event time. "0 before" refers to the part of the month of the event prior to the event, and "0 after" refers to the part of the month of the event after the event.

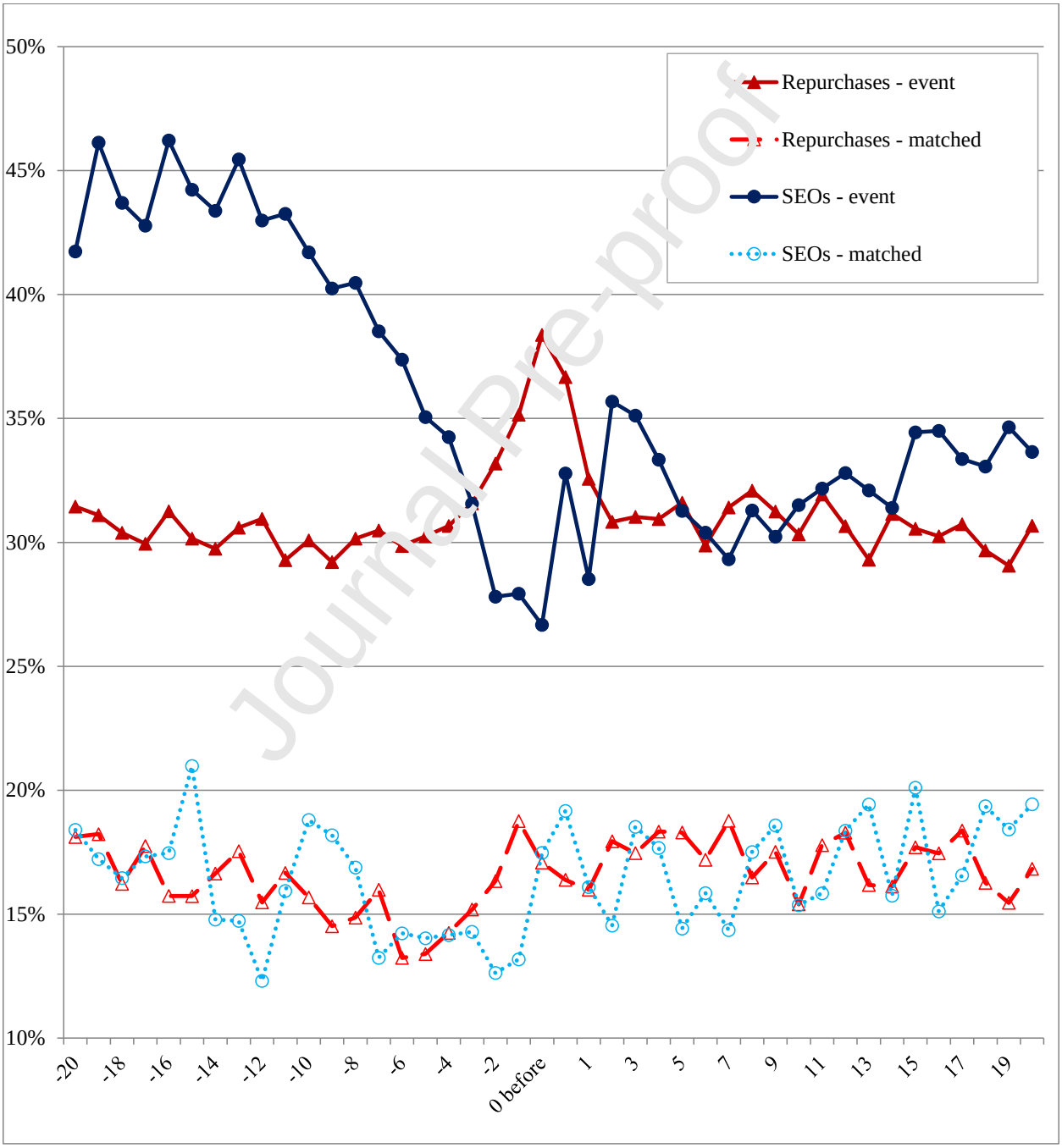

Figure 3. The frequency of insider trading in the months around corporate events

Data on insider trading are from Thomson Reuters. The figure shows the percentage of firms with insider trading around repurchases and SEOs. An event month is defined to have insider trading if at least one purchase or sale is made by insiders of the firm in that month. The solid line marked with triangles shows insider trading around repurchases, and the dashed line marked with circles shows insider trading around SEOs. The data are shown in event time. "0 before" refers to the part of the month of the event prior to the event, and "0 after" refers to the part of the month of the event after the event.

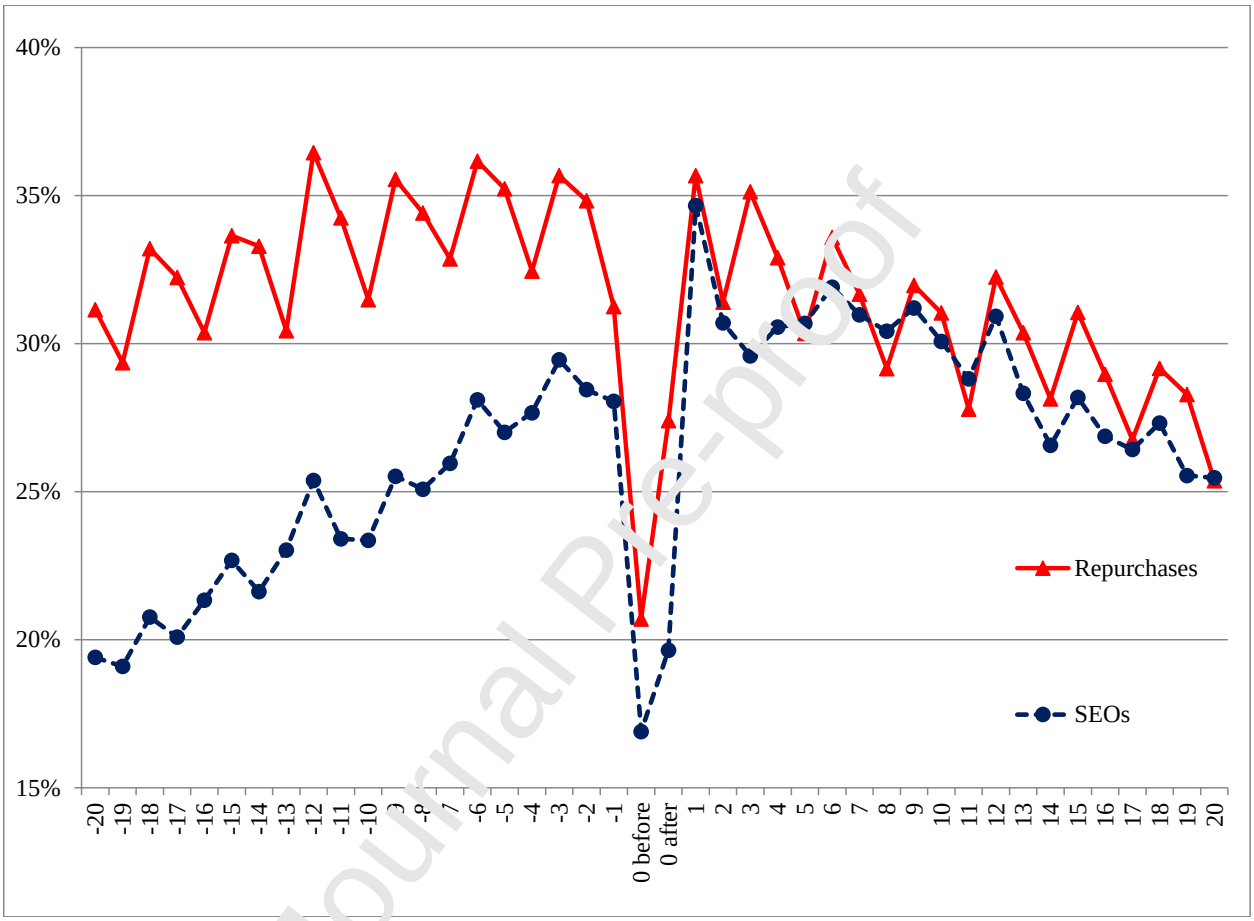

Figure 4. The frequency of insider trading in the months around corporate events: changes during the sample period

Data on insider trading are from Thomson Reuters. The figures show the percentage of firms with insider trading around repurchases and SEOs for four subperiods within our sample period. An event month is defined to have insider trading if at least one purchase or sale is made by insiders of the firm in that month. The solid line marked with triangles shows insider trading around repurchases, and the dashed line marked with circles shows insider trading around SEOs. The data are shown in event time. "0 before" refers to the part of the month of the event prior to the event, and "0 after" refers to the part of the month of the event after the event.

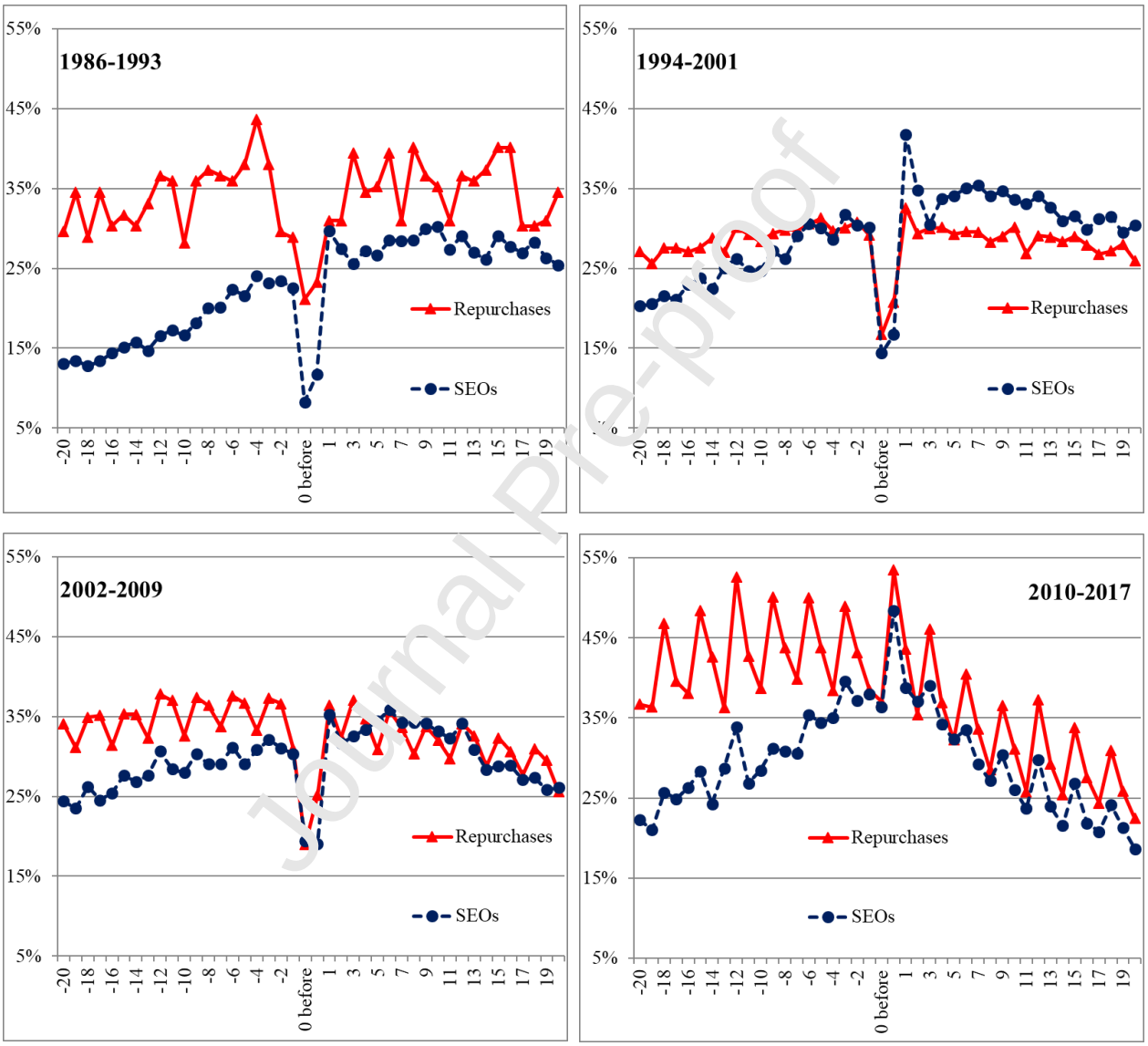

Figure 5: Coefficient estimates over time

These graphs plot estimates of the coefficients on *Net buy volume* and on *Event × Net buy volume* from the regressions in Tables 3-7, estimated separately for each calendar year of the sample with sufficient data. The graphs on the left plot coefficient estimates for repurchases, and the graphs on the right for SEOs. The vertical axis of the graphs in rows 1 and 2 measures the coefficient of *Net buy volume*, and the coefficient of *Event × Net buy volume* in rows 3, 5, and 6. In row 4, the vertical axis of the graph for repurchases (left) shows the coefficient of *Net buy volume*, and the graph for SEOs (right) shows the coefficient of *Event × Net buy volume*.

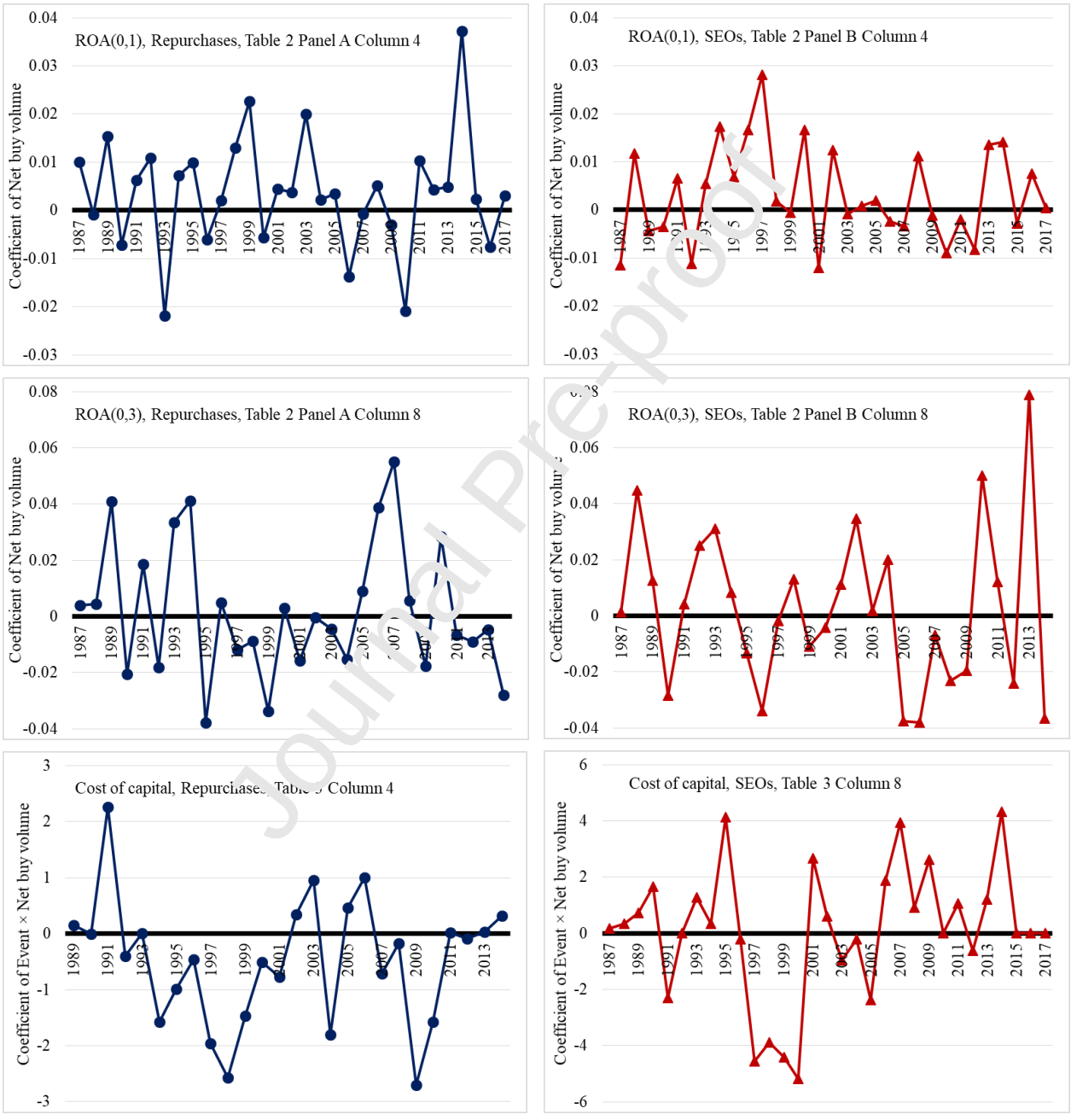

Figure 5 – continued

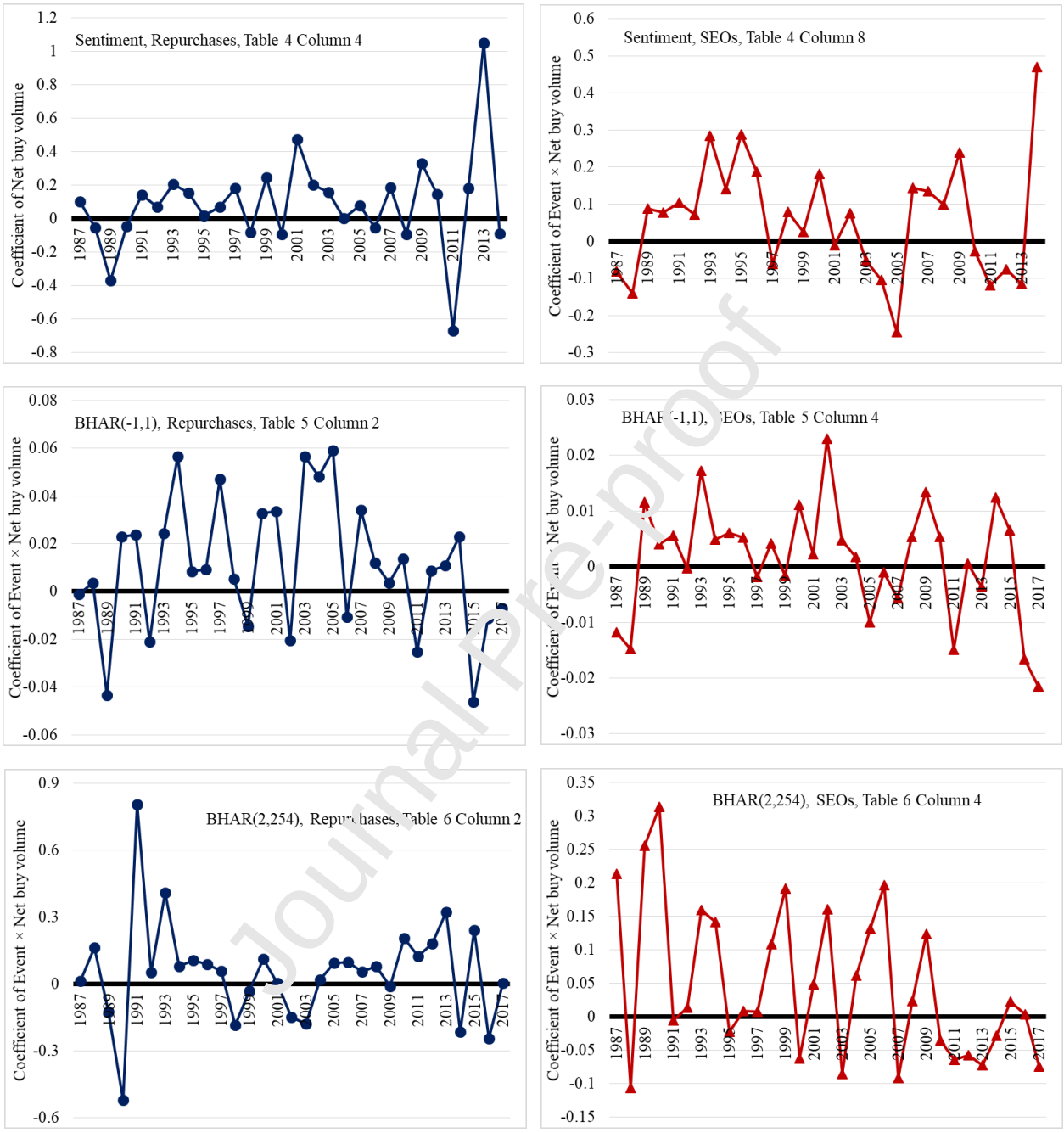

Table 1: Descriptive statistics

This table reports descriptive statistics of our sample of repurchases (left panel) and SEOs (right panel) collected from SDC Platinum for the period 1986-2017. We include events in which we have two years of stock return data available in CRSP prior to the event. *Ret6* and *Ret12* are the cumulative stock returns of the firm measured over a period starting six and 12 months before the event, and ending in the month before the event. *% sought* is the number of shares authorized for repurchase scaled by the number of shares outstanding at the time of the announcement. *Value* is the market value of the repurchase programs or the SEO. *Offer size* is the number of shares offered divided by the total number of shares outstanding prior to the SEO. *Net buy count* is defined as the (number of purchases – number of sales)/(number of purchases + number of sales) over the six-month period ending one month before the event. *Net buy volume* is defined as (number of shares purchased – number of shares sold)/(number of shares purchased + number of shares sold) over the six-month period ending one month before the event. *Total assets*, *market capitalization*, and the *value* of shares repurchased (sold) are measured in millions of dollars.

Repurchases				**SEOs**			
	Mean	Median	Standard deviation		Mean	Median	Standard deviation
Size, valuation, and profitability							
Total assets	3,520	800	6,252		2,081	532	3,615
Market capitalization	4,224	988	7,353		1,657	515	2,793
M/B	2.9681	2.3225	2.0792		3.4414	2.4608	2.7962
ROA	0.1571	0.1491	0.0831		0.1023	0.1268	0.1410
Past returns							
Ret6	-0.0357	-0.0314	0.2529		0.4164	0.2931	0.4999
Ret12	0.0557	0.0273	0.3692		0.6875	0.4679	0.8234
Size of repurchases/SEOs							
% sought	7.52	5.93	5.72	Offer size (%)	29.19	20.16	28.81
Value	22.47	4.26	52.11	Value	181.10	94	244.97
Insider trading 6 months prior to the event							
Net buy count	-0.5066	-1	0.7646		-0.5201	-1	0.7575
Net buy volume	-0.5640	-1	0.7625		-0.5785	-1	0.7516
Observations		4,920				2,069	

Table 2: Univariate analysis of insider trading and firm fundamentals, sentiment, and stock returns

Average abnormal returns and changes in fundamentals and sentiment following repurchases and SEOs, across quintiles of insider net buying. The columns report averages of the outcome variable listed at the left of the row for the lowest and highest quintile of *Net buy count* (first three columns) and *Net buy volume* (last three columns), and the result of a two-sample t-test for the null hypothesis that the outcome variable is equal across the two quintiles. *Net buy count* is defined as the (number of purchases – number of sales)/(number of purchases + number of sales) over the six-month period ending one month before the event. *Net buy volume* is defined as (number of shares purchased – number of shares sold)/(number of shares purchased + number of shares sold) over the six-month period ending one month before the event. *Decrease in the cost of capital* (market beta/size beta/valuation beta*) larger than sample s.d.* are dummy variables indicating whether the post-event decrease in the respective variable is larger than the cross-sectional standard deviation of the variable. By definition, they are set to 0 for firms in which the respective variable increases following the event. The top half of the table reports results for repurchases and the bottom half for SEOs.

Repurchases	Net buy count			Net buy volume		
	Low (q1)	High (q5)	t-test high-low	Low (q1)	High (q5)	t-test high-low
BHAR(-1,1)	0.014	0.038	7.25***	0.014	0.037	7.21***
BHAR(2,254)	0.002	0.292	9.69***	0.002	0.282	9.70***
Change in ROA (0,1)	-0.012	-0.010	0.77	-0.012	-0.010	0.91
Change in ROA (0,3)	-0.024	-0.010	3.16***	-0.024	-0.009	3.34***
Change in the cost of capital	-1.164	-2.630	-4.23***	-1.164	-2.499	-3.79***
Decrease in the cost of capital larger than sample s.d.	0.185	0.299	-4.68***	0.185	0.308	-5.02***
Change in market beta	-0.143	-0.278	3.65***	-0.143	-0.249	2.90***
Change in size beta	-0.049	-0.138	1.95*	-0.049	-0.168	2.59***
Change in valuation beta	-0.015	-0.088	1.52	-0.015	-0.083	1.41
Decrease in market beta larger than sample s.d.	0.232	0.285	-2.16**	0.232	0.263	-1.26
Decrease in size beta larger than sample s.d.	0.198	0.243	-1.86*	0.198	0.243	-1.93*
Decrease in valuation beta larger than sample s.d.	0.343	0.342	0.06	0.343	0.348	-0.20
Change in sentiment from (t-1) to (t+1)	-0.031	0.035	1.98**	-0.031	0.029	1.80**

Table 2 – continued

SEOs	Net buy count			Net buy volume		
	Low (q1)	High (q5)	t-test high-low	Low (q1)	High (q5)	t-test high-low
BHAR(-1,1)	-0.024	-0.017	2.81***	-0.024	-0.016	3.08***
BHAR(2,254)	-0.318	-0.187	5.1***	-0.318	-0.168	5.84***
Change in ROA (0,1)	-0.010	-0.007	0.90	-0.010	-0.006	1.30
Change in ROA (0,3)	-0.027	-0.014	2.33**	-0.027	-0.017	1.82**
Change in the cost of capital	-3.250	-2.815	0.67	-3.250	-2.627	0.97
Decrease in the cost of capital larger than sample s.d.	0.220	0.200	0.52	0.220	0.211	0.23
Change in market beta	-0.240	-0.241	0.01	-0.240	-0.248	0.11
Change in size beta	-0.261	-0.204	-0.48	-0.261	-0.200	-0.50
Change in valuation beta	-0.295	-0.116	-1.59	-0.295	-0.163	-1.15
Decrease in market beta larger than sample s.d.	0.213	0.181	0.88	0.213	0.186	0.73
Decrease in size beta larger than sample s.d.	0.193	0.187	0.16	0.193	0.205	-0.33
Decrease in valuation beta larger than sample s.d.	0.363	0.316	1.07	0.363	0.304	1.37
Change in sentiment from (t-1) to (t+1)	-0.184	-0.047	3.71***	-0.184	-0.039	3.92***

Table 3: Insider trading before corporate events and changes in operating performance

This table shows the results of regressions of changes in operating performance on insider trading for repurchases and SEOs, and matched non-event firms. *ROA* is return on assets. *Net buy count* is defined as the (number of purchases – number of sales)/(number of purchases + number of sales) over the six-month period ending one month before the event. *Net buy volume* is defined as (number of shares purchased – number of shares sold)/(number of shares purchased + number of shares sold) over the six-month period ending one month before the event. *Event* is a dummy variable that equals 1 if the observation is a repurchase (SEO) and 0 if the observation is a matched non-event firm. Non-events are matched to events based on size, B/M ratio, past six-month returns, and past six-month insider trading. Panel A shows results for repurchases, and Panel B shows results for SEOs. Underneath each coefficient we show t-statistics based on heteroscedasticity-robust standard errors, clustered at the firm level. *, **, and *** indicate that the coefficient or difference in means is statistically significant at the 10%, 5%, and 1% level, respectively.

	Panel A: Repurchases							
	Change in ROA (0,1)				Change in ROA (0,3)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(
Net buy count	0.0011		0.0037**		0.0051**		0.0100***	
	(0.710)		(2.143)		(1.977)		(3.435)	
Net buy volume		0.0005		0.0036**		0.0045*		0.008
		(0.351)		(2.073)		(1.785)		(3.
Event			-0.0061***	-0.0064***			-0.0136***	-0.01
			(-2.954)	(-2.996)			(-4.092)	(-3.
Event × Net buy count			-0.0031				-0.0058	
			(-1.418)				(-1.603)	
Event × Net buy volume				-0.0035				-0.0
				(-1.617)				(-1.
ln(Total assets)	0.0012**	0.0011**	0.0011**	0.0011**	0.0028***	0.0028***	0.0011	0.0
	(2.193)	(2.096)	(2.488)	(2.412)	(2.671)	(2.633)	(1.481)	(1.
B/M	0.0092***	0.0093***	0.0097***	0.0098***	0.0288***	0.0289***	0.0234***	0.023
	(3.419)	(3.435)	(4.745)	(4.780)	(3.760)	(3.758)	(5.224)	(5.
Ret6	0.0075	0.0075	0.0013	0.0013	-0.0135**	-0.0137**	-0.0189***	-0.01
	(1.359)	(1.345)	(0.401)	(0.390)	(-2.279)	(-2.301)	(-4.482)	(-4.
Constant	-0.0230***	-0.0229***	-0.0170***	-0.0168***	-0.0530***	-0.0527***	-0.0252***	-0.02
	(-4.540)	(-4.512)	(-4.724)	(-4.646)	(-4.891)	(-4.843)	(-3.884)	(-3.
Observations	4,210	4,210	8,420	8,420	3,341	3,341	6,682	6,
Adjusted R-squared	0.006	0.006	0.005	0.005	0.022	0.022	0.023	0.
Mean of dependent variable	-0.011	-0.011	-0.009	-0.009	-0.020	-0.020	-0.016	-0.

Table 3 – continued

	Panel B: SEOs							
	Change in ROA (0,1)				Change in ROA (0,3)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Net buy count	0.0033*		0.0055**		0.0064**		0.0108***	
	(1.915)		(2.401)		(2.124)		(2.694)	
Net buy volume		0.0036**		0.0053**		0.0055*		0.0121***
		(2.120)		(2.362)		(1.864)		(3.081)
Event			0.0004	0.0005			0.0004	-0.0012
			(0.137)	(0.195)			(0.082)	(-0.262)
Event × Net buy count			-0.0026				-0.0052	
			(-0.907)				(-1.051)	
Event × Net buy volume				-0.0021				-0.0074
				(-0.749)				(-1.533)
ln(Total assets)	0.0038***	0.0038***	0.0029***	0.0029***	0.0046***	0.0046***	0.0034***	0.0035***
	(4.827)	(4.878)	(5.303)	(5.290)	(3.424)	(3.407)	(3.765)	(3.813)
B/M	0.0080***	0.0079***	0.0085***	0.0085***	0.0185***	0.0187***	0.0219***	0.0219***
	(3.936)	(3.941)	(4.718)	(4.707)	(4.274)	(4.327)	(5.635)	(5.668)
Ret6	0.0014	0.0014	0.0002	-0.0003	-0.0078***	-0.0079***	-0.0113***	-0.0113***
	(0.813)	(0.820)	(-0.140)	(-0.153)	(-2.702)	(-2.734)	(-4.255)	(-4.278)
Constant	-0.0363***	-0.0361***	-0.0308***	-0.0306***	-0.0550***	-0.0551***	-0.0482***	-0.0471***
	(-6.219)	(-6.177)	(-6.745)	(-6.685)	(-5.566)	(-5.564)	(-6.489)	(-6.327)
Observations	2,428	2,428	4,856	4,856	2,005	2,005	4,010	4,010
Adjusted R-squared	0.013	0.013	0.010	0.010	0.023	0.022	0.025	0.026
Mean of dependent variable	-0.010	-0.010	-0.011	-0.011	-0.026	-0.026	-0.025	-0.025

Table 4: Insider trading before corporate events and changes in the cost of capital

Regressions of changes in the cost of capital on insider trading for repurchases and SEOs, and matched non-event firms. *Net buy count* is defined as the (number of purchases – number of sales)/(number of purchases + number of sales) over the 6-month period ending one month before the event. *Net buy volume* is defined as (number of shares purchased – number of shares sold)/(number of shares purchased + number of shares sold) over the 6-month period ending one month before the event. *Event* is a dummy variable that equals 1 if the observation is a repurchase (SEO) and 0 if the observation is a matched non-event firm. Non-event firms are matched to event firms based on size, B/M ratio, past six-month returns, and past six-month insider trading. All regressions control for *Ln(total assets)*, *B/M*, and past 6-month returns (*Ret6*). The coefficients of these controls are unreported. We obtain estimates for changes in the cost of capital from the three-factor model:

$$r_{it} - r_{ft} = \alpha_{-i} + \alpha_{\Delta i} D_t + b_{-i}(r_{mt} - r_{ft}) + b_{\Delta i} D_t (r_{mt} - r_{ft}) + s_{-i} SMB_t + s_{\Delta i} D_t SMB_t + h_{-i} HML_t + h_{\Delta i} D_t HML_t + e_t,$$

where r_{it} is the monthly return on stock i, r_{ft} is the monthly return on one-month U.S. Treasury bill, r_{mt} is the monthly return on the NYSE/AMEX/Nasdaq value-weighted index, SMB_t is the difference between the monthly return on a portfolio of small firms and the monthly return on a portfolio of large firms, HML_t is the difference between the monthly return on a portfolio of high B/M stocks and the monthly return on a portfolio of low B/M stocks, and D_t is a dummy variable that equals one if $t \geq t^*$, where t^* is the month of the event (repurchase or SEO). We use a 73-month window (−36 to +36) to estimate the parameters of the regression model. b_{-i}, s_{-i}, and h_{-i} are the factor loadings (betas) of firm i during the three years prior to the event. $b_{\Delta i}$, $s_{\Delta i}$, and $h_{\Delta i}$ are the changes in the factor loadings after the event. We exclude observations in which the absolute value of the change in cost of capital is greater than the cost of capital before the event. We also exclude observations in which the cost of capital before the event is negative. Columns 1-4 show results for repurchases, and columns 5-8 show results for SEOs. *, **, and *** indicate that the coefficient or difference in means is statistically significant at the 10%, 5%, and 1% level, respectively.

	Dependent variable: Change in the cost of capital							
	Repurchases				SEOs			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Net buy count	-0.3907**		-0.3913		0.0488		0.3955	
	(-2.002)		(1.495)		(0.148)		(1.164)	
Net buy volume		-0.3334*		0.2832		0.1106		0.2237
		(-1.699)		(1.094)		(0.339)		(0.646)
Event			-0.8357***	-0.8065***			-0.1822	-0.0696
			(-2.971)	(-2.731)			(-0.440)	(-0.162)
Event × Net buy count			-0.8152**				-0.3251	
			(-2.564)				(-0.710)	
Event × Net buy volume				-0.6589**				-0.0974
				(-2.091)				(-0.215)
Constant	-4.6862***	-4.6907***	-3.4134***	-3.4487***	-4.2097***	-4.1800***	-4.7165***	-4.7334***
	(-6.715)	(-6.716)	(-6.130)	(-6.174)	(-3.406)	(-3.395)	(-5.799)	(-5.791)
Controls as in Table 3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,644	1,644	3,288	3,288	966	966	1,932	1932
Adjusted R-squared	0.023	0.023	0.017	0.017	0.03	0.03	0.027	0.027
Mean of dependent variable	-1.495	-1.495	-1.445	-1.445	-2.965	-2.965	-2.698	-2.698

Table 5: Insider trading before corporate events and changes in investor sentiment

This table shows the results of regressions of changes in the cost of capital on insider trading for repurchases and SEOs, and matched non-event firms. *Net buy count* is defined as the (number of purchases – number of sales)/(number of purchases + number of sales) over the 6-month period ending one month before the event. *Net buy volume* is defined as (number of shares purchased – number of shares sold)/(number of shares purchased + number of shares sold) over the 6-month period ending one month before the event. *Event* is a dummy variable that equals 1 if the observation is a repurchase (SEO) and 0 if the observation is a matched non-event. Non-events are matched to events based on size, B/M ratio, past six-month returns, and past six-month insider trading. *Sentiment* is measured as the firm-specific component from the market-to-book decomposition of Rhodes-Kropf et al. (2005, p. 577, equation (15)). The dependent variable in all regressions is the change in sentiment from the year before the event (t-1) to the year after the event (t+1). All regressions control for *Ln(total assets)*, *B/M*, and past 6-month returns (*Ret6*). The coefficients of these controls are unreported for brevity. Columns 1-4 show results for repurchases, and columns 5-8 show results for SEOs. *, **, and *** indicate that the coefficient or difference in means is statistically significant at the 10%, 5%, and 1% level, respectively.

	Dependent variable: Change in sentiment from year (t-1) to year (t+1)							
	Repurchases				SEOs			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Net buy count	0.0259*		0.0559**		0.0449*		0.0020	
	(1.858)		(2.673)		(1.832)		(0.132)	
Net buy volume		0.0335**		0.0725**		0.0496**		-0.0005
		(2.331)		(2.843)		(2.239)		(-0.043)
Event			0.0367	0.0295			-0.0763***	-0.0688***
			(1.058)	(0.789)			(-4.877)	(-4.243)
Event × Net buy count			-0.0274				0.0483*	
			(-1.004)				(2.142)	
Event × Net buy volume				-0.0352				0.0554**
				(-1.168)				(2.529)
Constant	-0.0677	-0.0663	-0.1581***	-0.1509***	-0.4059***	-0.4015***	-0.2634***	-0.2642***
	(-1.289)	(-1.250)	(-3.486)	(-3.232)	(-3.980)	(-3.973)	(-4.438)	(-4.512)
Controls as in Table 3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,812	3,812	7,624	7,624	1,568	1,568	3,136	3,136
Adjusted R-squared	0.06	0.061	0.05	0.052	0.065	0.066	0.047	0.047
Mean of dependent variable	-0.030	-0.030	-0.043	-0.043	-0.150	-0.150	-0.107	-0.107

Table 6: Insider trading and announcement returns around repurchases and SEOs

This table provides the results of regressions of buy-and-hold abnormal returns around events and matched non-event firms on measures of insider trading. The dependent variable in columns 1 and 3 is the buy-and-hold abnormal return (*BHAR*) for the event window (-1,1) around the announcement of the event. The dependent variable in columns 2 and 4 is the buy-and-hold abnormal return (*BHAR*) for the event window of two days to 254 days following the announcement of the event. Buy-and-hold abnormal returns are calculated using the Carhart four-factor model as the benchmark, and an estimation window beginning 270 days before and ending 20 days before the event to calculate factor betas. Columns 1 and 2 show results for repurchases, while columns 3 and 4 show results for SEOs. *Event* is a dummy variable that equals 1 if the observation is a repurchase (SEO) and 0 if the observation is a matched non-event. Non-event firms are matched to events based on size, B/M ratio, past six-month returns, and past six-month insider trading. *Net buy volume* is defined as (number of shares purchased – number of shares sold)/(number of shares purchased + number of shares sold) over the six-month period ending one month before the event. All other independent variables are defined in Table 1. Underneath each coefficient we show t-statistics that are based on heteroscedasticity-robust standard errors, clustered at the firm level. We also report the mean of the dependent variable separately for events and for the matched non-events. Asterisks next to the means indicate whether the means are significantly different from zero. Asterisks next to the t-test indicate whether the mean for events is significantly different from the mean for non-events. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent variable: Buy-and-hold abnormal returns			
	Repurchases		**SEOs**	
	BHAR(-1,1)	BHAR(2,254)	BHAR(-1,1)	BHAR(2,254)
	(1)	(2)	(3)	(4)
Event	0.0262***	0.0989***	-0.0152***	-0.0644***
	(12.375)	(4.331)	(-8.347)	(-2.866)
Net buy volume	-0.0004	0.0903***	-0.0001	0.0228
	(-0.257)	(4.714)	(-0.075)	(1.306)
Event × Net buy volume	**0.0122*** **	**0.0406***	**0.0035***	**0.0530** **
	(5.310)	**(1.658)**	**(1.909)**	**(2.454)**
Ret6	-0.0098***	-0.4489***	-0.0018	-0.1451**
	(-2.744)	(-10.220)	(-1.420)	(-2.521)
Event × ret6	0.0053	0.0582	-0.0019	-0.0469
	(0.941)	(0.910)	(-1.006)	(-0.772)
Constant	-0.0006	0.0353**	-0.0031***	-0.0796***
	(-0.390)	(1.995)	(-2.600)	(-4.749)
Observations	7,596	7,596	3,658	3,706
Adjusted R^2	0.027	0.074	0.045	0.116
Mean of dependent variable	0.0122	0.0479	-0.0135	-0.201
Mean for events	0.0191	0.0709	-0.0220	-0.276
Mean for non-events	0.0001	0.007	-0.0033	-0.0281
t-stat difference	-12.12***	-5.84***	14.28***	10.88***

Holding period	Event			Control			Difference
	Low net buy count	High net buy count	Difference high - low	Low net buy count	High net buy count	Difference high - low	Difference high-low for event-control
			Repurchases - equally weighted				
3	0.70***	1.80***	1.10**	0.18	-0.41	-0.59	1.69**
	(0.20)	(0.54)	(0.56)	(0.37)	(0.59)	(0.67)	
6	0.55***	1.54***	0.99**	0.28	-0.10	-0.38	1.37**
	(0.17)	(0.39)	(0.42)	(0.32)	(0.39)	(0.45)	
12	0.39**	1.26**	0.87***	0.26	0.82*	0.56	0.31
	(0.16)	(0.30)	(0.31)	(0.22)	(0.43)	(0.46)	
			Repurchases - value weighted				
3	0.78***	0.93***	0.15	0.47	0.54	0.07	0.08
	(0.23)	(0.47)	(0.52)	(0.30)	(0.71)	(0.79)	
6	0.42**	0.84**	0.42	0.44*	0.22	-0.22	0.64
	(0.21)	(0.42)	(0.49)	(0.24)	(0.53)	(0.59)	
12	0.52***	1.05***	0.53	0.50**	0.54	0.04	0.49
	(0.18)	(0.31)	(0.34)	(0.22)	(0.39)	(0.45)	
			SEOs - equally weighted				
3	0.003	0.93	0.93*	-0.56**	-0.09	0.47	0.46
	(0.26)	(0.48)	(0.52)	(0.22)	(0.49)	(0.51)	
6	-0.07	0.25	0.32	-0.30**	-0.23	0.07	0.25
	(0.19)	(0.40)	(0.42)	(0.15)	(0.39)	(0.41)	
12	-0.30**	0.13**	0.43	-0.09	-0.04	0.05	0.38
	(0.14)	(0.27)	(0.28)	(0.12)	(0.27)	(0.29)	
			SEOs - value weighted				
3	0.41	0.81	0.40	-0.03	0.33	0.36	0.04
	(0.31)	(0.51)	(0.60)	(0.35)	(0.52)	(0.59)	
6	0.32	0.74	0.42	0.13	-0.02	-0.15	0.57
	(0.24)	(0.45)	(0.48)	(0.26)	(0.44)	(0.49)	
12	0.32*	0.54*	0.22	0.09	-0.03	-0.12	0.34
	(0.19)	(0.34)	(0.38)	(0.21)	(0.37)	(0.41)	

Table 7: Calendar-time portfolios using insider trading information around repurchases and SEOs versus a matched control sample

For each month, we form portfolios using information on the announcement of share repurchases and SEOs, and insider trading in the six months prior to the announcement. A firm is included in the low (high) net buy count event portfolio if it experienced an event (repurchase or SEO) in the past *t* months, and its net buy count over the six months prior to the event is -1 (+1). *Net buy count* and *net buy volume* are defined in Table 1. Similarly, a matched control firm is included in the low (high) net buy count control portfolio if it is matched to an actual event (repurchase or SEO) and its net buy count over the past six months is -1 (+1). The table shows monthly alphas from a Carhart four-factor model for each of these portfolio strategies for holding periods of *t* = 3, 6, and 12 months. *High–low* in columns 4 and 7 shows the alpha for a portfolio that goes long in high net buy count firms and shorts low net buy count firms. Finally, *Difference high–low for event–control* in column 8 shows the difference between

the alphas on the long-short portfolios in columns 4 and 7. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% level, respectively.