Tournament incentives and insider trading

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Abstract

I use a stacked diff-in-diff regression to show that high-rank non-CEO directors will trade on their private negative information more aggressively after they have lost the CEO promotion opportunity. Consistent with the prediction of the tournament incentives model, these non-promoted directors intentionally make more opportunistic sell transactions to compensate themselves for the forgone pay rise associated with the CEO position. They trade on the future worsening in firm performance, investor sentiment and the increase in the cost of capital to reap an abnormal return. I use instrumental variables to address the reverse causality concern, and to show that the existence of insider trading opportunity causes the well-documented positive relationship between tournament incentives and firm performance to be weaker.

Keywords: Insider Trading; Tournament Incentives; Director Compensation; Career Outcome
JEL Classification: G14; G11; G12; G40; G41

[1] I thank seminar participants at UTS Business School, University of Technology Sydney. Any errors remain my own responsibility.

Introduction

On 1st November 2016, The Toro Company (NYSE: TTC) internally promoted Richard M. Olson to be the next CEO, replacing the eleven-year incumbent Mr Michael J. Hoffman, with a subsequent increase in his total compensation package from $1.5 million to $4 million. The other three internal CEO candidates who missed out on the promotion and the remuneration awards stayed with the firm. The following year, they executed seven sell transactions that resulted in an average yearly abnormal buy-and-hold return of -13.78% and generated 40.43% (41.89%) lower yearly abnormal returns than their sell transactions executed one year (two years) before the CEO decision was made.

I investigate why such non-promoted directors' transactions become drastically more informative after losing the CEO promotion opportunity. I argue that the loss of future promotion opportunity and the forgone rise in compensation associated with the CEO position motivate them to exploit their informational advantage by trading on their private information more aggressively. I base our argument on the intersection between tournament incentives and insider trading literature.

The former has established that firms hold promotion tournaments by making several top employees compete for a single more senior position promotion-based prize, which is the increase in compensation (DeVaro, 2006; Kale, Reis and Venkateswaran, 2009). Cvijanovic, Gantchev and Li (2021) show that 83.6% of S&P 1500 firms do not have a formal CEO succession plan and hold open CEO tournaments for competition. Employees are willing to accept contracts that offer them explicit incentives such as annual salary and bonuses below the optimal levels for their effort, because they value the chance of future promotion; they incorporate the expected increase in the explicit incentives associated with the promotion into their contracts (Lazear and Rosen, 1981; Main, O'Reilly and Wade, 1993). At the highest level of the corporate hierarchy, the CEO position and pay are the only promotion destination and ultimate tournament prize that senior non-CEO directors are incentivised to exert efforts to win. Kale, *et al.* (2009) find a positive relationship between the amount of pay increase non-CEOs expect to receive if they successfully realise the promotion-based incentives and firm performance.

However, senior directors who lose the first CEO promotion tournament during their time in the firm see a significant reduction in their likelihood of winning the next round of CEO tournament in the same firm. Consequently, there is a drastic decline in the overall value of tournament losers' contracts because the value of their implicit promotion-based incentives is much lower, if not foregone completely. Since firms are restrained from adjusting their contracts to compensate them for the forgone compensation opportunity and restoring the explicit incentives to the optimal level (Chan, Evans and Hong, 2019), more competent directors leave the firm to participate in other firms' tournaments rather than face compensation contract below the optimal level, in line with the high turnover rate among senior directors observed empirically following the appointment of a new CEO (Chan *et al.*, 2019; Gregory-Smith and Wright, 2019).

I hypothesise that non-promoted directors who choose to stay with the firm, and costly to layoff, will be motivated to compensate themselves for the forgone promotion opportunity by exploiting their private information more aggressively because their contracts are now worth less, and the explicit incentives are below the optimal level. One strategy is to trade on more price-sensitive private information to generate higher abnormal returns as corporate insiders are closely involved with the firm's daily operation and have superior access to price-sensitive information and trading on this price-sensitive information is profitable and rarely attracts the market regulator's attention (Ali and Hirshleifer, 2017).[2] Empirical evidence has unanimously documented that corporate insiders actively trade on their private information regarding their firms' future to generate excess returns, resulting in return predictabilities following both insider purchase and sell transactions (Lakonishok and Lee, 2001; Cohen, Malloy and Pomorski, 2012; Biggerstaff, Cicero and Wintoki, 2020). Their transactions become drastically more informative before some specific corporate events, such as the release of quarterly earnings announcement (Ali and Hirshleifer, 2017), around M&A rumour (Davis *et al.*, 2020), when there is a worsening in the industry level information environment (Contreras and Marcet, 2020), and if they narrowly miss their performance-based bonus (Gao, 2019). This evidence suggests that insiders will intentionally trade on their private information more aggressively when the expected gain is large enough to outweigh the associated litigation risk and to maximise their private benefits. I extend this evidence by assessing the extent to which the gains from their trades will compensate them for the foregone CEO promotion opportunity.

I use a sample of 165,705 US non-CEO director's insider transactions undertaken by 21,723 non-CEO insiders between 1996 and 2019 to assess whether non-promoted directors will trade on their private information with greater aggressiveness following the loss of CEO promotion opportunity. One main concern in the insider trading literature is endogeneity, which I document, as the true motivations behind insider transactions, including private information, personal liquidity need and portfolio diversification, are not directly observable, leading to random post-transaction returns, and the omitted variable bias will subsequently result in inconsistent estimates. I use two approaches to mitigate this problem. Firstly, I specify a stacked diff-in-diff regression based on matched sample to isolate the losing CEO tournament effect within the event year $(-2, 1)$. I match our test firms with a control group without CEO turnover by total assets, average insider trading profitability and book-to-market ratio one year before our test firms' CEO turnover. Second, I additionally apply two-stage least square (2SLS) estimator by using the age of former CEO who has left the firm on average six years ago, as instrumental variable (IV) to further generalise the finding outside our event window.

[2] In a traditional insider trading model, an informed agent's trading aggressiveness α is increasing in his risk tolerance (Cespa, 2008). Since there is a decrease in insider's overall compensation value, her risk tolerance should become higher because the expected loss of losing her job is lower if they are prosecuted for illegal insider trading. Consequently, I hypothesise that insiders will bear higher litigation risk and trade on their private information more aggressively.

I find that non-promoted insiders execute more opportunistic sell transactions in the next two years after losing the CEO promotion, but no significant change in their opportunistic purchase transactions' propensity after losing the CEO promotion. I document that the insider purchase (sell) transactions systematically generate more positive (negative) abnormal returns in the year that these non-promoted directors lose CEO competition, and the profitability of their sell trades persists one year after the CEO turnover. I find that the buy trades executed by insiders in the year of losing their CEO competition yield on average 24.5% higher one-year BHAR than these transactions would have generated without CEO turnover. For the sell trades, the corresponding average treatment effect is 3.0% more negative returns in year 0 and 4.8% more negative in year one. I report that for firms that planned a CEO successor prior to the tournament, the losing tournament effect becomes weaker, consistent with the hypothesis that assigning a CEO successor is a way of depressing the discontent among non-promoted directors.

I conduct additional tests to investigate the motivations behind these informed insider trades. I focus on two non-mutually exclusive hypotheses: (i) compensation for the forgone CEO promotion prize known as *forgone incentives hypothesis*, or (ii) exploiting the stock mispricing after a major corporate change referred to as *stock misevaluation hypothesis*. In the first case, I expect insiders with larger pay difference with their CEO before the tournament outcome to trade on their private information more aggressively because of the higher opportunity loss than insiders whose compensation is already close to the current CEO's. In the same logic, the increase in the return predictability should be higher for younger insiders than older ones because the former have a higher expected value on the promotion-based components in their remuneration contracts as their career horizons are longer. In contrast, the latter are closer to their retirement and should have placed less importance on the future promotion opportunity. Similarly, I conjecture that short investment horizon insider sellers also have shorter career horizons because they frequently reverse their previous buy positions to reduce their ownerships (Akbas, Jiang and Koch, 2020). Thus, they will trade with lower aggressiveness to compensate themselves for the forgone promotion opportunity. Our results support these hypotheses for insiders' sell trades, suggesting that they trade on negative insider information for personal gains and probably to undermine the performance of the newly promoted CEO.

To test for the firm-level informativeness, I follow Tucker and Zarowin (2006) and construct the future earnings response coefficient, and Piotroski and Roulstone (2004) to calculate the return synchronicity. I expect insiders' sell trades to be less profitable when the future earnings response coefficient is lower, and their buy trades not to vary with these two firm-level informativeness measures. I find no significant relationship between the return synchronicity and insider transaction profitability. I show that the change in insider trading profitability is robust to the inclusion of these two proxies, suggesting that the increase in profitability is not solely attributed to insiders trading on the stock misevaluation, but a way of compensating themselves for the forgone CEO promotion opportunity. I

investigate the informational content behind these more informed insider transactions to further show that the higher abnormal profit is not randomly driven by unobservable stock and market movement. I find their sell trades systematically predict the future decreases in both return on asset and investor sentiment, and an increase in the future cost of capital, but this is not the case for their purchases.

Inspired by these results, I investigate the possibility that insiders will trade to realize their promotion awards before the announcement of the next CEO. If they can trade *ex-post* the tournament, there is nothing to prohibit them from trading *ex-ante*. Consequently, the positive causal effect between the tournament incentives and firm performance may not be as high as documented by Kale *et al.* (2009). To investigate this possibility, I first replicate the results of Kale *et al.* (2009). I show that the positive causal relationship between tournament incentives and firm performance persists in our sample period. Following Kim and Lu (2011), I further use the sum of the maximum marginal federal and state long-term capital gain tax rates as our IV for the total non-promoted insider trading transactions. I find a weaker causal relationship between the tournament incentives and firm performance when non-CEO insiders execute more transactions, further confirming our hypothesis that insiders trade to realise their tournament incentives *ex-ante* the release of the tournament outcome.

I consider that tournament competitors may avoid trading on their private negative information that adversely lower their winning probabilities, and tournament losers are more likely to be those insiders who trade on their private negative information more aggressively. I employ two approaches to address this possible reverse causality. First, a 2SLS estimator to generalize the results outside the CEO turnover event window and investigate whether the increase in insider trading profitability is significantly higher than their unconditional return predictabilities. I use as an IV the former CEO's age in the last fiscal year, which is a publicly available information, not correlated with the firm's future fundamental that insiders are exploiting because former CEO left the firm six years ago on average, but it empirically embeds predictive power for the future CEO turnover. I show that the increase in the return predictability embedded in both insider purchase and sell trades following the CEO turnover persists when I take insider transactions outside the CEO turnover event window into consideration. The more negative abnormal return predictability embedded in insider sell transactions persists two years after losing the CEO promotion opportunity. Their sell, but not their buy, trades yield more negative abnormal returns when the newly appointed CEO increases her holdings, suggesting that they intentionally incorporate more negative private information into their transactions to trade against the current CEO, in line with Armstrong *et al.* (2020) who argue that that newly appointed CEO is likely to be noisy trader. Second, I show that insider transactions embed little predictive power for the CEO promotion outcome in our robustness tests. Furthermore, I consider that insiders will dissimulate their private negative information by making sequential sell transactions and randomly mixing with uninformative purchase transactions to thwart outsiders and market regulators. I show that the losing CEO competition effect becomes stronger after accounting for this insider trading strategy.

To test the appropriateness of our matching algorithm, I follow Angrist and Pischke (2009) and Cengiz *et al.* (2019) and conduct an event-study type diff-in-diff regression to show the parallel trend assumption. I further test the validity of the exclusion restriction of our IV by considering the possibility that former CEOs may have adapted long-lasting corporate policies, affecting a firm's future fundamentals. I additionally include another fourteen control variables that proxy for the possible channels in which the age of a former CEO can indirectly affect the firm's future value. I find robust results and provide evidence that the exclusion restriction of our IV is satisfied. Furthermore, I show that former CEO's age contains little predictive power for non-CEO insider trading return outside the CEO turnover event, further stressing the exclusion restriction plausibility. I also find robust results when I use different return proxies, control for performance-induced CEO turnover, and when I remove firms with a COO prior to the tournament and CFO trades. I construct pseudo-CEO turnovers to show the robustness of our diff-in-diff regression and conduct 1,000 placebo tests for diff-in-diff and 2SLS regression separately to rule out the possibility that these significant results are due to luck.

I contribute to the literature from three aspects. First, I focus on two streams of literature, tournament incentives and insider trading, which although both study the directors' behaviours, the ongoing investigations in these two domains are largely parallel and do not intersect. To the best of our knowledge, this is the first empirical analysis to bridge these two streams of literature. I show that insider trading is affected by the realisation of their tournament incentives. Second, I contribute to the tournament incentives literature by documenting an unintended consequence of holding a CEO tournament that is causing more aggressive insider trading activities. Moreover, this is the first paper to report that insider trading opportunity weakens the positive effect of tournament incentives on firm performance documented by Kale *et al.* (2009). Our results imply that the compensation committee must consider the opportunity of trading on private information to set out the optimal level of tournament incentives because the tournament incentives are not as effective as the compensation committee reckoned as tournament rejectees can compensate themselves *ex-post*. Unlike most tournament incentive studies; our paper uniquely focuses on these rejectees and I shed light on losing competitors' investment decisions to show that their career concern affects their trading decisions. Finally, I contribute to the insider trading literature by documenting one more corporate event in which insiders systematically incorporate more private information into their trading decisions to seek higher abnormal returns. The study suggests that insiders adjust their trading strategies depending on their career concerns and the forgone pay rise, an unexplored area in insider trading literature.

The remainder of the paper proceeds as follows. In Section I, I review the relevant literature. Section II describes our sample and the constructions of variables, justifies the exclusion and relevance conditions of our IV and specifies our regression. Section III presents the empirical results and revisits the results of Kale *et al.* (2009) by accounting for the role of insider trading opportunity. Section IV presents the 2SLS estimation results, robustness, and placebo tests. The conclusions are in Section V.

I. Literature Review and Hypotheses development

A CEO promotion tournament involves a contest amongst senior executives to become the firm's next CEO. The winner will receive the corresponding promotion-based monetary rewards, such as remuneration, perks, and other privileges. The increase in the winner's compensation package, referred to as the tournament incentives, is possibly the largest in her lifetime. The losers will either be laid off, but at a cost, stay in the same firm and wait for the next chance for advancement, or leave to participate in tournaments in other firms (Lazear and Rosen, 1981; Gibbs, 1995; DeVaro, 2006). Boards hold promotion tournaments to encourage agents to exert effort, identify the most suitable senior manager for the CEO position, and improve firm performance.

Theorists have supported the logic behind the tournament-type CEO succession. In the tournament incentives model developed by Lazear and Rosen (1981), Gibbons and Murphy (1992) and Main, O'Reilly and Wade (1993), senior executives endure pay below the optimal market rates because they not only value the explicit incentives such as the regular increase in their salaries, stock options and annual bonuses but incorporate the implicit value of the future promotion opportunity. The implicit value of the future promotion opportunity depends on both the subjective probability of being promoted and the subsequent increases in their compensation packages if they eventually win the promotions (Kale *et al*,2009). Gibbons and Murphy (1992) show that an optimal incentive contract must optimise the combination of employee's career concern regarding future promotion opportunity and the current explicit incentives. Thus, if the employee is close to her retirement, the subjective probability of future promotion becomes lower, which attributes to the lower expected promotion-based incentives. Consequently, the director will place, to a great extent, more importance on explicit incentives and not value the future promotion opportunity. In the same logic, Holmstrom and Milgrom (1994), and Baker, Gibbs and Holmstrom (1994) have documented the complementarity between explicit and implicit incentives components in designing the optimal remuneration contract. Ederhof (2011) studies the pay structure of a multinational firm in a single year and shows that firms adjust the pay structures of their mid-level managers with fewer promotion levels to reach in the corporate hierarchy by substituting the weaker promotion-based incentives with higher bonus-based incentives, a form of explicit incentives. In the same vein, Gibbs (1995) argues that the tournament prize must rise at an increasing rate when executives are moving up to the corporate hierarchy because principles need to maintain a large enough incentive for those senior executives who already receive relatively high compensations. As a result, the pay disparity is most pronounced between the CEO and other non-CEO senior executives[3], reflecting the strongest implicit incentives at the top level of the hierarchy and justifying the largest compensation gap between the CEO and other senior directors observed in real life.

[3] For example, Adamson, Canavan and Ziemba (2020) report that CFOs make one-third of CEO pay, and have relatively lower compensation increases and a smaller proportion in the form of stocks and LTIP.

I argue that an additional implication of these tournament incentives models is the behaviour of the promotion "rejectees", as the loss of a CEO tournament lowers drastically the promotion-based component in their contract, resulting in a decrease in their overall value of their compensation plan, because of, at least, the following four reasons. First, the timing and the outcome of the next round of the tournament is uncertain (DeVaro, 2006), and the higher the hierarchical level of the non-promoted director, the fewer the promotion opportunities, as the only promotion destination is the CEO position, a long-tenure job which can be occupied for an average of nine years, but up to twenty-three years in our US sample[4]. Second, the negative image of a previous tournament loser will further lower the probability for the senior director to be promoted to the CEO position in the next tournament, further lowering the expected value of promotion opportunity in their contracts, and, consequently, their contracts' overall value.[5] Third, there is a fundamental difference between implicit promotion-based and explicit performance-based awards, as the former is only possible to realise with the occurrence of a promotion, unlike the explicit incentives such as annual salary increases or bonuses which are recurring and relatively predictable incomes that directors will receive without promotion (DeVaro, 2006). Becoming the next CEO in the firm is the ultimate victory and is the only way to fully realise the CEO promotion prize. The uncertainty about the timing of the next promotion opportunity jointly with the lower probability of winning the next promotion leads to a lower value of promotion-based incentives. Finally, firms will not adjust the explicit incentives to compensate the non-promoted directors for losing the tournament. The most accepted explanation is that the adjustment cost of restructuring the incentive plan for non-promoted directors is high at the end of a tournament. Morck, Shleifer and Vishny (1988) implicitly assume that firms' ability to realign managers' incentives is constrained when the adjustment cost is high. The adjustment cost is responsible for the suboptimal equity ownership level in managers' incentive contract in their sample. Similarly, Core, Guay and Larcker (2003) argue the firms' transaction costs prohibit continuous re-contracting. Therefore, a subset of firms will always have misaligned incentives because their transaction costs overweight the benefits of a properly aligned incentive.

Empirically Gibbs (1995) examines the incentive scheme of a single large hierarchical firm using longitudinal data to show that firms do not adjust their incentive plans to compensate non-promoted directors for reducing the promotion-based incentives, leading to a lower overall incentive plan and a gradual decline in their performance rating. Chan et al. (2019) show that, on average, the largest 1500 U.S. firms do not significantly increase any short-term, long-term, and total compensation contracts of tournament losers following the CEO turnover, because the high adjustment cost curbs firms to compensate the tournament losers *ex-post*, and such compensation will weaken the *ex-ante* tournament incentives. Bushman, Dai and Zhang (2016) show high adjustment costs associated with

[4] Gregory-Smith and Wright (2019) report an average CEO turnover frequency of 7.6 years in the UK.
[5] Chan et al. (2019) estimate a probit model to show the expected probability of winning a future CEO tournament significantly decreased from 27.4% to 9.4% after directors lose their first tournament while there is no significant increase in the number of competitors in the future tournament.

issuing equity constrain firms' abilities to restore the optimal pay-performance sensitivity. Kale *et al.* (2009) find that firms will systematically provide a higher-level tournament incentive proxied by the larger pay gap between the CEO and the executive team's median compensation following a new CEO's appointment. The uncertainty regarding the future CEO promotion lowers the non-promoted directors' subjective probabilities of successfully realising the implicit promotion-based incentives in the next tournament. Therefore, firms must provide a higher incentive to maintain the same level of expected promotion-based incentives for non-promoted directors, as the pay disparity between senior directors and CEO becomes larger, and non-promoted directors are not compensated for losing the promotion.

However, previous studies assume a rather passive role of the promotion rejectees, who either accept the loss and the subsequent decrease in their compensation contract's overall value or leave the firm to participate in tournaments in other firms. I find that 68% of the tournament losers stay with the firm two years after the CEO turnover. I argue that extra traction may be gained by bridging the insider trading literature with the tournament incentives literature as the promotion rejectees have incentives to stay to exploit their informational advantage more assertively by conducting insider trading with greater aggressiveness. Since the promotion-based incentive represents an unrealised part of senior directors' remuneration contracts, they can materialise their private information regarding the firm's true future valuation to gradually make up the discrete losses in the valuation of their positions. This strategy, the existing tournament incentives studies have overlooked, is plausible because all CEO tournament competitors are high-ranked directors closely involved in their firms' daily operations, and they are privy to price-sensitive information which they can trade on. Although the SEC prohibits corporate insiders from trading on any material private information, anecdotal evidence and empirical studies in insider trading literature have shown that corporate insiders can systematically earn abnormal return followings their transactions (Seyhun, 1986, 1992; Lakonishok and Lee, 2001; Cohen, *et al.*, 2012). Piotroski and Roulstone (2005) show that insiders actively trade on future earnings information, and Jiang and Zaman (2010) conclude that insider transactions can predict future cash flow information. Ali and Hirshleifer (2017) show that although many firms explicitly prohibit insiders from trading in the month before quarterly earnings announcements, many insiders violate the regulation when the expected monetary gain outweighs the litigation risk. They show that purchase (sale) transactions that occurred before the quarterly earnings announcements can predict a substantially higher (lower) abnormal return than in past insider literature. These results imply insiders actively trade ahead of privately known accounting information, and a timely disclosure does not deter them from materialising their informational advantage. The high profitability embedded in insider transactions persists from the 80s until today, even though insider trading regulation has tightened after the Sarbanes-Oxley act in 2002 implementation (Seyhun, 1992; Beneish and Markarian, 2019).[6]

[6]Sarbanes-Oxley act came into force in 30 July 2002. The implementation of this act shortened the reporting deadline to SEC from 10 days to 2 days after the end of the month in which insiders executed the transactions.

Roulstone (2003) finds that firms set up internal policies to restrict insider trading activity and offer their directors a premium for their forgone insider trading opportunity, as directors, *de-facto*, consider their trading opportunities as a way of compensating themselves. These results imply that promotion rejectees will trade more aggressively and profitably on inside information to make up the decreases in the overall valuation of their positions. They will also do so because they are "under the shadow" compared to the CEO who is exposed to the media, market regulators and investors scrutiny as Sabherwal and Uddin (2019) show that public visibility is one of the key determinants of insider transaction profitability. Moreover, Gao (2019) apply a regression discontinuity to compare directors who marginally missed their relative performance goals and lost their performance-based bonuses with otherwise similar directors who narrowly met the goals and received the bonuses. The results show a higher abnormal return following the former group's transactions, meaning they intentionally trade on their private information more aggressively to compensate themselves for the forgone bonuses, suggesting that insiders trade aggressively on private information to compensate themselves. Overall, I expect non-promoted insiders to trade abnormally and profitably after losing the tournament contests.

II. Sample and Variable Construction

I follow prior literature (Kale *et al.*, 2009; Kini and Williams, 2012) to identify CEO turnover event and collect director's compensation data from Execucomp, which covers S&P 1500 firms from 1996 to 2019, with the first CEO turnover event occurring in 1997. Our initial sample consists of 269,456 director-year observations with 4,838 CEO turnover events[7]. I use the annual CEO flag (*ceoann*) to identify the historical CEO changes. Throughout the study, our event window is $(-2, 1)$ relative to CEO turnover year 0, assuming that the tournament begins in year -2, and the losing tournament effect will gradually decay outside our event window. I additionally restrict that there is only one CEO turnover in the window (-2, 2) to remove confounding event.[8] I use CEO promotion and CEO turnover interchangeably to denote the change of CEO position and solely refer to non-CEO directors whenever I mention insiders, directors, or promotion rejectees unless specified otherwise.

I define tournament competitors as those covered by Execucomp but are not CEOs in their firms (Kale *et al.*, 2009; Kini and Williams, 2012). These filters will select tournament competitors relatively properly because Execucomp mainly covers the top five highest-paid directors in a firm, their only promotion destination is the CEO position. I reckon the total compensation package that a director receives better measures his seniority within the firm than his job title. I exclude three groups of insiders

[7] Very few firms have more than one CEO in a fiscal year. My results are robust to their inclusion/exclusion.
[8] My event window greatly affects my sample size. However, my results are robust if event window is extended to (-3, 3), narrowed to (-1, 1), restricted to cases with only one CEO turnover in $(-4, 2)$, or include all confounding events. I do not restrict other event years than CEO turnover year in the event window of other CEO turnover event because such restriction is effectively requiring that there is only one CEO turnover in ten years.

from the tournament competitor category because they are not actively competing in a CEO tournament: (i) insiders not covered by Execucomp in years (-2, -1) but gained coverage in years (0, 1) as they are either new joiner or low-rank directors who did not participate in the CEO tournament but gained the coverage of Execucomp after the tournament; (ii) those who have served as CEO in the firm in their lifetime but remain with the firm after stepping down from their position as they have both lower probability and fewer incentives to become the next CEO[9]; and (iii) founder and co-founder of the company identified by using the job title (*titleann*). The second and third filters greatly overlap because most founders and co-founders have served as the CEO of their firm in the past[10].

I use the item total compensation (*tdc1*) to construct the tournament incentive measure. Following Coles, Daniel and Naveen (2006) and Walker (2009), I adjust the total compensation item (*tdc1*) to account for the regulatory change of Financial Accounting Standards Board (FASB) 123R revision, as detailed in Appendix 1. I define tournament incentive as the logarithm of the difference between the CEO's total compensation and the median total compensation of other non-CEO directors (Kini and Williams, 2012; Coles *et al.*, 2014). I follow Kini and Williams (2012) and remove former CEO who remain in the firm as an executive role when identifying the median non-CEO director pay. I use Execucomp to collect our instrumental variable, the former CEO's age in the last fiscal year (*age*), and if the data is missing, I use BoardEx or searches on Factiva to complete our dataset.

I compiled all U.S. insider transactions from January 1996 to August 2019 from Smart Insider Ltd[11]. I keep all insider open market transactions in Form 4. I exclude transactions with less than 100 shares, in line with insider trading literature (Lakonishok and Lee, 2001; Cohen *et al.*, 2012), and any pre-scheduled trades, known as 10b5-1 trades, because the information content embedded is likely to be trivial[12]. I aggregate these insider transactions at the insider-day level. I compute the net purchasing value (NPV) as the purchase transaction dollar value minus sell transaction dollar value over the total dollar value[13] to measure insider trading direction. If *NPV* is greater (less) than 0, I recognise that the

[9] For example, Bill Gates (*execid*: 00635), the co-founder of Microsoft became the "Chief Soft Architect" upon his retirement and continue to be covered by Execucomp.
[10] My results are robust if I include these three types of non-CEO directors.
[11] This database (https://www.smartinsider.com/), formerly known as Directors Deal Ltd, gathers information from Form 5, the annual statement of change in beneficial ownership and reports any and exempt transactions not reported on Form 4. Previous studies, including (Fidrmuc, Korczak and Korczak, 2013; Goergen, Renneboog and Zhao, 2019) used it.
[12] To minimise the impact of insider transaction on the stock price, SEC allows insider to pre-announce their transaction plan before the actual transaction date. Directors will relinquish director control over the plan and allow their brokers to execute their pre-announced transactions on the pre-determined date. As an example, Bill Gates has a long-term 10b5-1 plan and has been regularly selling more than 2 million common shares of Microsoft each year over the last 20 years.
[13] In literature, net purchasing ratio, which is the ratio of the amounts of shares traded over the total amount of shares traded, is an alternative measure of insider trading direction (Lakonishok and Lee, 2001). In unreported result, I repeat all regression by using NPR as well, and the result is virtually unchanged.

insider is net buying (selling) on a given day. I exclude the 0.3% of our matched insider trading sample with *NPV* equal to 0 from our final sample.

I match Execucomp's unique director identifier *execid* to Smart Insider's non-unique insider identifier *personid* to build a link table between these two databases. I use BoardEx to cross-check the validity of our *execid-personid* match. For 48,429 distinct *execid* in Execucomp, I successfully match 43,952 (90.8%) of them with 44,187 *personid.* I matched 42,358 of 46,720 (90.7%) distinct *execid* for non-CEO directors. I discard the unmatched *execid* from our sample as they have not reported any transactions on Form 4. I collect stock price and holding period return data from CRSP. I exclude non-common shares with share code (*shrcd*) 10 or 11 and small stocks priced under $2 at the beginning of a calendar year. I extract all financial accounting and financial data from Compustat. Appendix 2 shows the sample sizes across these three databases.

I use the CRSP value-weighted market index return to adjust the holding period return and compute the buy-and-hold (BHAR) abnormal return for holding period *t* as follow:

$$BHAR_{it} = \prod_{i=1}^{t}(1 + return_{t+i}) - \prod_{i=1}^{t}(1 + mkt_{t+i}) \quad (1)$$

where $return_{t+i}$ is the holding period return, mkt_{t+i} is the benchmark return for the holding period t+i. I measure BHAR one day after the transaction date of insider trade. Section 16(b) of the Security Act of 1934 prohibits corporate insiders from profiting from any short-term price movement. Under the "short-swing profit" rule, directors must return any profit from two opposite transactions within six months. Therefore, the literature commonly focuses on twelve-month holding return for studying the price discovery and long-term market efficiency improvement attributed to insider trading (Anginer, Hoberg and Seyhun, 2018). Following the literature, I focus on the 365-calendar day as the holding period. A common problem that any daily-level study will encounter is that the trading day's numbers in the next 365 days vary depending on the transaction date. I restrict a valid *BHAR* must have at least 243 trading days in the holding period as suggested by Agrawal and Nasser (2012). I further collect analyst coverage data from I/B/E/S. Appendix 3 presents the constructions of all the variables.

Table 1 reports the annual distribution of CEO turnover event, the number of external CEO promotions, the number of non-CEO director samples, the matched insider sample, and the average shares and average value that insiders purchases and sales. In column (1), the highest CEO turnover year occurred in 2008, the financial crisis year, and the second highest is in 2001, the year the dot-com bubble busted. In total, there are 4,838 CEO turnovers from 1997 to 2019, averaging 210 events per year, with 24% of them (1,178) external promotion (Column (2)), consistent with the 28% reported by Cziraki and Jenter (2020). Column (3) shows no obvious trend in Execucomp's coverage of non-CEO directors in each fiscal year.

After removing any confounding events, our sample size reduces to an unreported 3,428, accounting for 71% of our total sample. 1,259 out of 3,428 firms did not report any insider transactions in year 0, which leaves 2,169 events in our final sample, account for 63% of the universal isolated CEO turnover event as displayed in column (4). However, our results are robust to the inclusion of the confounding events. Column (5) and (6) report the annual distribution of the 13,022 matched insider purchase and the 152,273 sell transactions submitted by non-CEO directors, and column (7) and (8) their respective monetary values. The proportion of the number of buy trades of 8% is significantly lower than the 37% reported by say Lakonishok and Lee (2001) or the 20% overall number in our database, suggesting that non-CEO are more likely to sell, but the average value of their trades is relatively smaller than our unreported CEO's average purchase (sell) transaction value is $532,510 ($2,804,729) in our sample period.

[Insert Table 1 here]

Endogeneity Concern and Identification Strategy

One major concern in insider trading literature is endogeneity as insiders' sell transactions are less informative because they trade for reasons other than profit-seeking, such as portfolio diversification and personal liquidity need. Corporate insiders' personal wealth is highly concentrated on their firms because they not only receive salaries from their firms, but the compensation committee will frequently award them with free shares and stock options to align their interests with shareholders. Therefore, the excess idiosyncratic risk they undertake by over-concentrating their portfolios on their firms will motivate them to gradually unwind their share positions to diversify (Huddart and Ke, 2007). Similarly, they can liquidate their holdings for personal consumptions or other unobservable purposes. In the same vein, their purchase transactions are not exempted from endogeneity because the true motivation behind their trading decisions is not observable; they may acquire stocks because they believe the firm is undervalued, for controlling purposes, or even to signal fake firm undervaluation when there is an increase in short interests (Wu, 2019). The omitted variable bias will lead to an inconsistent OLS estimate for the losing tournament effect. I use an extensive set of explanatory variables to control for insider trading return and include firm and month fixed effects to proxy for time-invariant unobservable variables to eliminate potential endogeneity[14].

Nevertheless, I recognize that these approaches do not completely solve the endogeneity issue. I follow Cengiz *et al.* (2019) and Baker, Larcker and Wang (2021) and specify a stacked diff-in-diff regression based on a matched sample as our baseline regression to eliminate the concern that unobservable market anticipation will bias our results. I select control firms with no CEO turnover in (-2, 2) by matching our test firms with a firm with the shortest Mahalanobis distance on the average

[14] In unreported results, I replicate all diff-in-diff regressions with firm and year fixed effects, all my results remain robust.

insider purchase/sell profitability, logarithm of the total asset and the book-to-market ratio in the year *t-1*, in line with Berger, Kick and Schaeck (2014) who focus on CEO turnover. I match one treated firm with one control firm to minimize the biasedness. Among all 547 firm-year observations with at least one insider purchase transaction in the CEO turnover event year, I successfully match 192 out of 547 (35%) treated firm observation with 192 control firm-year observations, resulting in 1,775 firm-year observations[15]. For firms with at least one insider sell transaction, I matched 1,331 of 1,775 (75%) observations with 1,331 control firm-year observation. Our sample size varies depending on the availability of the *execid-personid* link table and the different control variables included. The comparative analysis of the subsequent insider trading profitability across these two samples can better disentangle the incremental change solely attributable to the loss of CEO turnover within our event window. I estimate a diff-in-diff regression to study whether the return predictability of insider purchase (sell) transactions remains the same or systematically increases (decreases) in and/or after the CEO events by focusing on our event window only. Our diff-in-diff regression is specified as follows:

$$\text{BHAR\_m\_365}_{i,t} = \alpha + \beta_1 \text{Post}_{i,t} + \beta_2 \text{Treat}_{i,t} + \beta_3 \text{Post}\times\text{Treat}_{i,t} + \beta_4 CEO\_IT_{I,t} + \text{controls} + \gamma + \rho + u_i \quad (2)$$

where γ and ρ are firm and month fixed effect, respectively. I cluster our standard errors at the firm-month level as Alldredge and Blank (2019) show that insiders cluster their trades with their colleagues. Subscripts *t, d* and *m* are for fiscal year, trading day and month, respectively. The time dimension of the control variables is matched on the insider transaction date instead of the CEO turnover event.[16]

The dependent variable is the 365-day adjusted buy-and-hold abnormal return (BHAR) using the value-weighted CRSP index. The main independent variables include treatment dummy $treat_i$ that equals to one for our treated firms, the post-treatment period dummy $post_t$ that equals to one for year *t*, and their interaction $treat \times post_t$. I focus on two years from 0 to + 1 post-CEO tournament outcome, depending on the specific focus period. If there is a systematic increase (decrease) in the return predictability embedded in insider purchase (sell) transaction after losing the CEO tournament, β_3 should be positive (negative) and statistically significant. I also include $CEO\_IT_{I,t}$ to proxy for the CEO trading direction and to capture the trading strategy that non-CEO insiders time their transactions based on the current CEO's trading activity. Armstrong *et al.* (2020) show that newly appointed CEO is systematically more likely to make noisy purchase transactions to signal their commitments to improve the firm's performance, not necessarily to seek a profit, but to prolong their tenure even if they underperform, yet the market reacts positively, overvaluing the firm. These buy trades systematically

[15] The relatively low number of insider purchase firms matched is because many firms do not report insider purchase transactions in years (-2, -1). I tried various schemes to match on their past insider trading profitability, matching on year -1 yields the most suitable results.

[16] My results remain robust if I match the time dimensions of these control variables in my first stage regression to the CEO turnover event by using the end of last month figure in the last fiscal year. However, to better control for the firm characteristics that will affect insider trading profitability, I prefer to match the dimension with insider transactions. My results also remain unchanged if I include both the one-fiscal year lagged control variables and one-month lagged control variables in my first and second stage regression.

generate low long-term abnormal returns, leading non-promoted insiders to adopt contrarian strategies by selling overvalued shares and increasing their trading profitability.[17] To account for this strategy, I first compute the net insider trading value of a CEO in the year *t* as the difference between the aggregated value of insider sell and purchase transactions, which I then divide into annual quintiles to get $CEO\_IT_{I,t}$ as the quintile number. If the CEO is not trading in year t, the selling and buying values are zero, but the lower the $CEO\_IT_{I,t}$, the more shares the CEO has purchased in the year *t*.

To capture the incremental increase in return predictability solely attributed to the forgone CEO promotion opportunity rather than the firm performance improvement contributed by the CEO turnover, I include various control variables in our regression to account for the return predictability explained by firm and insider personal characteristics (Lakonishok and Lee, 2001; Cohen *et al.*, 2012). I assess whether insiders' intensity of exploiting their private information advantage is different if the firm promoted an outsider or/and the firm had appointed a successor prior to the tournament by computing a dummy equals to one for the insider transactions in $(0, 1)$ for firms that promoted an outsider CEO, and a dummy equals to one for the insider transactions in $(0, 1)$ if the CEO succession was planned in $(-2, -1)$. I measure the tournament incentive at the firm level by computing the natural logarithm of the difference between the adjusted CEO total compensation and the median adjusted total compensation of other insiders, and at director level a dummy variable equals to one for high incentive directors and zero otherwise. To rank directors, I use the difference in the adjusted total compensation between CEO and directors, the best proxy for the potential increase in remuneration packages if promoted to be the next CEO[18]. The highest rank is for non-CEO directors whose promotion-based implicit compensation is the largest in their firms. I define high incentive directors as those whose total difference is in the top three in their companies, given that the median and mean ranks are three. I control for the firm's recent and long-term stock price momentum, growth, profitability, size, innovation level using last year research and development cost, the Amihud (2002) illiquidity measure, and the financial analyst coverage that controls the firm's information environment. I also control for some personal characteristics that can affect insiders' trading returns, including personal wealth risk (Beneish and Markarian, 2019) by following Core and Guay (2002) to calculate the performance-based incentives as a dollar change in director *i*'s wealth associated with a 1% change in the firm's stock price (in $000), and Coles, Daniel and Naveen (2006) to calculate the risk-taking incentives, a dollar change in director *i*'s wealth associated with a 0.01 change in the standard deviation of the firm's returns (in $000). Finally, I control for firm's financial health using the yearly industry average S&P long-term

[17] Armstrong *et al.* (2020) show that the market reaction to the purchase transactions executed by CEO who successfully (failed to) prolonged her tenure in the next year is positive (negative). Since I removed all the confounding events in my sample, all the CEOs in my post-tournament period prolonged their tenures.

[18] In some rare cases, some non-CEO directors have higher compensation than CEO, such as Bill Gates (*execid*: 00635) continued to be compensated significantly more than Steven Ballmer, who took over Gates' CEO position. I restrict the difference in total compensation to be zero and my result is robust with or without those outliers.

rating, which summarises industry risk and can predict forced CEO turnover by assigning AAA a value 2 to CC a value of 23, and scale these ratings by dividing by 9, so one unit in the increase in the scaled rating corresponding to an increase in rating from AAA to BBB and from BBB to CCC, following (Peters and Wagner, 2014). I exclude years in the post-tournament period but are not my focus year *t* to better disentangle the change in return predictabilities embedded in directors' transactions and compare their post-tournament returns with their unconditional returns.[19]

Table 2 provides the summary statistics of my variables for buy (Panel A) and sell (Panel B) after removing the confounding events and only focusing on event windows of (-2, -1) and (0, 1) to assess whether insiders and firm characteristics are significantly different before and after the CEO turnover events. Panel A shows that the 365-calendar day BHAR embedded in insider purchase transaction before the CEO tournament is 5.9%, increasing significantly to 30.4% in the post-tournament period, suggesting that corporate insider actively trade on their private information, in line with previous insider trading literature (Lakonishok and Lee, 2001; Cohen et al., 2012), but also to compensate themselves for the forgone promotion opportunity as their average total_compensation declines significantly from $1.5million in (-2,-1) to $1.07 million. The momentum, mom, a proxy for long term stock returns, is 0.059, significantly higher than the 0.00% after the tournament, suggesting that insiders often make purchase transactions to support the price when their stocks perform poorly.

Similarly, Panel B shows that their sell trades are more profitable as they yield 5.7% BHAR before the CEO turnover, decreasing significantly to 2.6% post-tournament period. They are more likely to adopt contrarian strategies by buying (selling) when the long-term and short-term momentum stock return, as proxied by mom, ret30, are lower (higher) and book to market higher (lower) in line with previous evidence (Lakonishok and Lee, 2001; Cohen et al., 2012). Non-CEO insiders tend also to buy (sell) in smaller firms and those with lower (high) pay_gap_firm and total_compensation, ROA, and sell-side analyst coverage, and in firms that are less (more) liquid. I find, but do not report for brevity that these BHARs for both buy and sell trades are relatively more pronounced for non-promoted insiders and depend on whether the promoted CEO is an external, the CEO succession is planned by having a Chief Operating Officer and the incentives are high. I account for these factors in my regressions.

[Insert Table 2 here]

One drawback of diff-in-diff estimator in this research setting is that I can only compare the post-tournament insider trading profitability in year $(0, 1)$ with pre-tournament insider trading profitability in year $(-2, -1)$. I must discard all samples outside year $(-2, 1)$. I further employ the 2SLS estimator to control the potential endogeneity and generalise the results outside my sample period. The estimator will enable me to compare the post-tournament insider trading profit with their

[19] For instance, for year 0 representing the CEO turnover year, I exclude year 1 from my sample to better capture the incremental change in the insider transactions predictability caused by losing the CEO competition.

unconditional ones outside the event window. The IV should embed predictive power for the CEO turnover event and one year after the event to satisfy the relevance condition, and should not correlate with the abnormal return of insider transaction, which proxies for non-promoted director's private information regarding the firm's future fundamentals to materialise their information advantage, to meet the exclusion restriction (Ali and Hirshleifer, 2017; Cziraki, Lyandres and Michaely, 2021). Insiders can also derive profitable incremental information from their economically-link industry peers' public information and trade on it (Alldredge and Cicero, 2015).

I select the former CEO age in the last fiscal year as a suitable IV in my setting[20]. The empirical findings of Weisbach (1988), Murphy and Zimmerman (1993), Parrino (1997), Peters and Wagner (2014), Cziraki and Jenter (2020) and Jenter and Lewellen (2021) justify the relevance condition, as they show that the CEO's age embeds significant predictive power for CEO turnover in addition to the CEO tenure and firms' performance and other firm-level characteristics[21]. Inspired by these results, I hypothesise that the age of the former CEO also embeds predictive power for the CEO turnover because the younger (older) the former CEO, the more likely the incumbent CEO had been replaced the firm less (more) recently[22], decreasing (increasing) the likelihood of a future CEO turnover[23]. Another advantage of using former CEO's age in the last fiscal year is that the IV embeds predictability not only for the year of CEO turnover, but also for one year after the CEO turnover. When I focus on $(0, 0)$, the CEO age in the last fiscal year is the previous CEO's age in $(-1, -1)$. I expect the older the previous CEO, the more likely the CEO turnover event. When my focus period is $(1, 1)$, the former CEO age in the last fiscal year is the age of the CEO who left one year ago, respectively. I expect these recently left CEOs are systematically younger than other former CEOs. I formally test the relevance condition in Table 8.

Although the exclusion condition is not formally testable, it is less of a concern. The average time distance between the year *t* and the year that the former CEO left the firm is six years. Thus, there is no obvious reason to believe that the age of the former CEO, who left six years ago, will affect the firm's future value, even if their corporate decisions have a long-lasting effect as these decisions are less likely to be correlated with CEO age, which previous studies find to be uncorrelated with corporate

[20] For example, to predict the probability of the CEO turnover for Skyworks Solutions Inc in 2016, I first check the former CEO of Skyworks, Thomas C. Leonard in 2015, born in 1934 and retired in 1999, and aged 82 in 2016. I use 82 as my IV in 2016 for the firm to predict the turnover probability of the current CEO David J. Aldrich.
[21] Performance is measured as average industry-adjusted monthly stock returns scaled by the standard deviation of returns as in Jenter and Lewellen (2021).
[22] The variation in the former CEO age is unlikely to capture the current CEO tenure because the correlation between the former CEO age and the current CEO tenure in the last fiscal year is 0.39. Furthermore, if I include the current CEO tenure in my 2SLS, all the first-stage F statistics remain well-above 20 and my 2SLS regression coefficients and significance remain overall robust but weaker. These results are presented in the robustness test.
[23] One disadvantage of using last fiscal year's former CEO age is that I discard all observations in my entire sample before the first CEO turnover. The sample size becomes drastically smaller. When I use the last fiscal year CEO's age as IV, the sample size is much larger, but all my results and conclusions remain the same. Nevertheless, I recognise that the age of former CEO is more exogeneous than that of the last fiscal year CEO.

policies decision making[24]. Moreover, since the former CEO's age is a public information, and insiders trade on the firm's future value that has not been fully incorporated into the current stock price (Seyhun, 1986; Lakonishok and Lee, 2001), I reckon that my IV can satisfy the exclusion restriction, and I employ the 2SLS estimator to study insider's trading propensity after losing the CEO turnover. Although the exclusion restriction is not testable, I conduct additional tests to rule out the possible channels that my IV can influence the insiders' private information in the robustness test to further show the exclusion restriction's plausibility.

I run two first-stage regressions to overcome endogeneity in my interaction variable. In the first-stage regression, the dependent variable is the non-promoted executive dummy $NPED_{I,t}$ that is equal to one for insider purchase or sell transactions executed by insiders in the post turnover year *t*, and zero for other years. In the second, the dependent variable is the endogenous interaction term ($\mathrm{NPED_{I,t}}\times\mathrm{CEO\_IT_{I,t}}$). The two first-stage regression specifications are as follows:

$$\mathrm{NPED_{i,t}}=\alpha+\beta_1\mathrm{age\_ceo_{j,\,t\text{-}1}}+\beta_2(\mathrm{age\_ceo_{j,\,t\text{-}1}}\times\mathrm{CEO\_IT_{i,t}})+\beta_3\mathrm{CEO\_IT_{i,t}}+\mathrm{control}+\mathrm{u_i} \quad (3)$$

$$(\mathrm{NPED_{i,t}}\times\mathrm{CEO\_IT_{i,t}})=\alpha+\beta_1\mathrm{age\_ceo_{j,\,t\text{-}1}}+\beta_2(\mathrm{age\_ceo_{j,\,t\text{-}1}}\times\mathrm{CEO\_IT_{i,t}})+\beta_3\mathrm{CEO\_IT_{i,t}}+\mathrm{control}+\mathrm{z_i} \quad (4)$$

where $\mathrm{age\_ceo_{j,\,t\text{-}1}}$ and the interaction term between my IV $\mathrm{age\_ceo_{j,\,t\text{-}1}}$ and the moderator variable $CEO\_IT_{I,t}$ as my first and second joint IV to predict the $NPED_{i,t}$ and $\left(NPED_{i,t}\times CEO\_IT_{I,t}\right)$.

In the second-stage regression, I replace the $NPED_{\mathrm{I,t}}$ and ($\mathrm{NPED_{I,t}}\times\mathrm{CEO\_IT_{I,t}}$) by the estimated $\widehat{NPED}_{\mathrm{I,t}}$, a continuous variable representing the predicted probability that a given insider purchase or sell transaction executed in the post-tournament year *t*, and $(\mathrm{NPED}\widehat{\times\mathrm{CEO}}\mathrm{\_IT})_{\mathrm{I,t}}$ as follows:

$$\mathrm{BHAR\_m\_365_{i,(d+1,d+365)}}=\beta_1\widehat{\mathrm{NPED}}_{\mathrm{i,t}}+\beta_2(\mathrm{NPED}\widehat{\times\mathrm{CEO}}\mathrm{\_IT})_{\mathrm{i,t}}+\beta_3\mathrm{CEO\_IT_{i,t}}+\mathrm{control}+\varepsilon_{\mathrm{i}} \quad (5)$$

If directors are indeed more likely to exploit their informational advantage to compensate themselves for losing the CEO tournament, I expect β_1 to be statistically significant and positive (negative) for insider purchase (sell) transactions. In the same logic, if directors increase their selling activities when the CEO is increasing their holdings to prolong her tenure, I expect β_2 to be statistically significant and positive for insider sell transactions. I include the same set of control variables and fixed effects.

[24]Other studies show that CEO age does not affect corporate decisions, such as governance changes (Nelson, 2005), and firm's cash holding (Liu and Mauer, 2011; Feng and Rao, 2018), total risk and idiosyncratic risk (Cen and Doukas, 2017), and performance (Palia, 2001; Brick and Chidambaran, 2010; Bhagat and Bolton, 2013)

III. Empirical results

Matching Results

Table 3 Panel A reports the results of matching my test firms with control firms with no CEO turnover in (-2, 1) with the shortest Mahalanobis distance on the average insider purchase or sell profitability, logarithm of the total asset and the book-to-market ratio in the year *t-1*, in line with Berger, Kick and Schaeck (2014). Firms that need to replace their CEOs are more likely to be underperforming, and therefore, it is necessary to ensure these control firms are also underperforming. I use changes in stock returns during the pre-event period, $\Delta\text{BHAR\_m\_365}_{(-2,-1)}$, as a proxy. The differences between the control and treated firms for both purchase and sell transaction samples are not statistically significant. Moreover, I find no statistical significance in size, book to market, and momentum and profitability, which are not used in my matching, indicating my matching procedure is appropriate. However, the average purchase transaction for the treated firm is statistically larger than that of control firms, and the non-CEO directors from treated firms receive 7% higher total compensation than their counterparts from control firms for sell sample, but I do not expect these significant differences to affect my results as, economically, they are relatively small.

Panel B reports the differences in BHARs during the event window -2 and +1. I observe that the difference in BHAR_m_365 between test and control firms for both insider purchase and sell samples are statistically indifferent from zero in the years (-2, -1), indicating our matching strategy is successful. I conclude that I fail to reject the hypothesis that there is a parallel trend in BHAR_m_365 between control and treated firms. Furthermore, the test firms generate higher BHAR_m_365 in year 0, and lower BHAR_m_365 in year 1 than control firm in purchase sample and yield lower returns in year 0 and 1 in sell sample, further supporting my hypothesis. I conduct a formal parallel trend assumption test following Angrist and Pischke (2009) and Cengiz *et al.* (2019). The coefficient of Pre_{-1} is statistically insignificant in both purchase and sell transaction samples, meaning the trend in (-2, -1) between control and treated firm is parallel after controlling for firm characteristics that can explain insider trading return. The parallel trend suggests that the post-tournament results are not driven by the matching algorithm's inappropriateness to obtain the control group and the use of the diff-in-diff estimator. The results are reported in Appendix 4.

Insider Trading Propensity around CEO tournament

I investigate whether insiders are more likely to execute opportunistic sell transactions by classifying insider transactions into opportunistic and routine traders, in line with Cohen *et al.* (2012). The former trades are executed by insiders who regularly trade in a clear pattern, which I define as trades in the same calendar month in the past three years, and the latter are discretionary trades that embed higher return predictability and more private information on average. I re-classify each insider at the beginning of each calendar year based on her past three years' trading history. I exclude insiders

who did not make any trades in the past three consecutive years. I follow the regression specification in Equation (2) and estimate the regression using the matched sample. In Table 3 Panel C, the dependent variable is $\text{opp\_D}_{I,t}$ that equals one for opportunistic transactions and zero for routine transactions.

Columns (1) to (2) show that there is no significant change in the propensity of executing opportunistic purchase transactions in two years because the coefficient of the interaction term $(\text{Treat}\times\text{Post})_{I,t}$ is insignificant. In contrast, columns (3) to (4) indicate a clear pattern in the insider sell trades. The positive and significant coefficient of $(\text{Treat}\times\text{Post})_{I,t}$ suggests an increase in the propensity of insiders to make opportunistic sell transactions in year $(0, 1)$. The coefficient of $\text{CEO\_IT}_{I,t}$ is positive and statistically significant suggesting that the newly appointed CEO's trading direction significantly determine the director's propensity to make opportunistic sell trades and that insiders are uniformly more likely to sell opportunistically if the newly appointed CEO is decreasing her holdings. I also find but not report that for the sell trades, the coefficient of the momentum control variable is positive and statistically significant, suggesting that insiders adopt contrarian strategies by selling when the stock return are high. Similarly, the negative and significant coefficient of $\text{bm}_{j,m-1}$ and the negative and significant coefficient of $\text{size}_{j,m-1}$ imply that opportunistic insider selling is more pervasive in small and growth stocks, and the sign and significance of the remaining control variables are consistent with the existing literature (Lakonishok and Lee, 2001).

Overall, these results suggest that insiders are more likely to make opportunistic sell transactions after losing the CEO competition in year (0,1). On the other hand, opportunistic sell transactions are more informative than an average sell transaction suggested by Cohen *et al.* (2012). In an unreported logit regression, I find that insiders are more likely to execute opportunistic sell trades than opportunistic purchase transactions after they have lost the promotion, consistent with my hypothesis. These findings are consistent with my hypothesis that insiders mainly incorporate more private information into their sell transactions to compensate themselves for losing the CEO competition. Furthermore, these results provide preliminary evidence that non-promoted insiders strategically time their transactions based on the trading activity of the newly appointed CEO.

[Insert Table 3 here]

Diff-in-Diff regression results

Table 4 reports the diff-in-diff estimation result. In column (2), the coefficient of the interaction term $(treat \times post)_{(0,0)}$ is statistically significant, implying that the buy trades executed by insiders after losing a CEO turnover tournament yields a 24.5% higher BHAR_m_365 that those generated without CEO turnover, *ceteris paribus*. However, it not significant in the remaining buy trades columns. Column (5) to (6) indicate that, the sell trades in treated firm systematically generate more negative BHAR_m_365 of between 3.0% in years (0,0) and 4.8% in year (1,1), than those of the control firms,

as the coefficients of the interaction term $(treat \times post)_{i,t}$ are negative and statistically significant. Using the average sell transaction value in year 0 and year 1, non-promoted insiders' sell transactions would yield $28,209 ($45,567) more profit if their transactions are made in the year 0 (year 1) than other non-CEO directors. The dollar profit is higher than the average profit of $12,000 reported by Cziraki and Gider (2021) between 1986-2013. Additionally, the abnormal dollar profit accounts for 2.1% (3.3%) of the average non-CEO director total compensation in year 0 (year 1), higher than the average 1.2% reported by Cziraki and Gider (2021) for all non-CEO directors covered by Execucomp.

The losing tournament effect is weaker for insiders who stay with a firm that had a CEO successor prior to the tournament because the coefficients of $COOD_{I,j}$ are in the opposite signs to the coefficients of $(treat \times post)_{i,t}$ for both insider purchase and sell samples. This evidence shows that a pre-assigned successor will serve to depress the discontent among directors effectively. Thus, they will react to the loss of CEO tournament with less intensity because their sell transactions do not generate as negative returns as their counterparts from a firm that did not have a CEO successor. Moreover, insiders mainly make sell transactions to compensate themselves because the losing tournament effect persists until year +1 in the insider sell sample. In contrast, the effect solely exists in the year of CEO turnover in the insider purchase sample. The short-term and long-term momentum variables, $ret30_{j,t,(d-1,d-30)}$ and $mom_{j,t,(d-31,d-364)}$ are both negative and mostly statistically significant for insider sell sample, but $mom_{j,t,(d-31,d-364)}$ is negative and statistically significant only in column (1) for insider purchase sample, suggesting that worst performing firms generate higher subsequent returns. The coefficient of $size_{j,m-1}$ is constantly negative and significant, consistent with the well documented size effect. Overall, the significance and signs of my control variables are consistent with other insider trading studies Cohen *et al.* (2012), Beneish and Markarian (2019) and Contreras and Marcet (2021).

[Insert Table 4 here]

Motivations behind more informed insider transactions

In the previous section, I have documented the change in the trading behaviour of non-promoted insiders following the loss of CEO competition. The remaining question is what motivate insiders to trade after losing the CEO promotion. I investigate two non-mutually exclusive hypotheses, insiders intentionally trade to compensate themselves for the forgone CEO promotion, which is referred as *forgone incentives hypothesis*, or may be trading to exploit the stock misvaluation after a major corporate change which is referred as *stock misvaluation hypothesis*.

If *forgone incentives hypothesis* is true, I should expect a stronger increase (decrease) in the BHAR_m_365 of transactions submitted by insiders whose tournament prizes are larger. Although I have controlled the pay disparity in the last fiscal year proxied by $high\_incentiveD_{I,t-1}$ in my previous

results, the historical pay disparity in year -1 is a more relevant measure for their tournament prizes if they had won the tournament. A larger tournament prize indicates a larger opportunity loss, and they should trade on their private information more aggressively. To better capture the promotion-based incentives that these promotion rejectees have forgone, I rank all tournament competitors by their total compensation in year -1 in their firms. The highest-ranked director is the highest-paid non-CEO directors after excluding directors who are not competing in the tournament. The higher (lower) the rank, the lower (higher) tournament incentives they had.

I further re-specify my diff-in-diff regression with a triple interaction term $(Post \times Treat \times Pay\_rank)_{I,t}$ and with the inclusion of additional three main level terms, $Pay\_rank_{I,t}$, $(Post \times Pay\_rank)_{I,t}$ and $\left(Treat_{I,t} \times Pay\_rank\right)_{I,t}$. If directors with high tournament prizes compensate themselves for the forgone promotion-based opportunity with greater intensity than other insiders, I expect the coefficient of the $(Post \times Treat \times Pay\_rank)_{I,t}$ to be negative (positive) and statistically significant for insider purchase (sell) transactions. I report the diff-in-diff regression results in Table 5 Panel A. I include the same set of control variables but omit their coefficients for brevity. Table 5 Panel A, shows that the coefficient of $(\text{Post}\times\text{Treat}\times\text{Pay\_rank})_{I,t}$ is statistically insignificant in column (1) and (2), indicating no difference between high prize director and low prize director when they make purchase transactions, but positive and statistically significant in column (3) and column (4), suggesting that the profitability of insider sell trades will decrease more for high incentive director in the first two years after the CEO tournament. The results are consistent with the hypothesis that directors with higher tournament incentives compensate themselves for the forgone promotion opportunity by exploiting negative private information with greater aggressiveness.

Another method to reaffirm the *forgone incentives hypothesis* is to check the age effect. Gibbons and Murphy (1992) show that directors close to their retirement age will place less importance on the promotion-based incentives. Consequently, I hypothesise that older directors will react to the loss of tournament with less intensity. In other words, the changes in the abnormal return of older directors will be less dramatic than younger directors. To test the hypothesis, I employ the natural logarithm of the current age of directors as the moderator variable. Table 5 Panel B presents the result. The coefficient of $(\text{Post}\times\text{Treat}\times\text{lnage})_{I,t}$ is insignificant in column (1) and (2), but positive and significant in column (3) and (4), in line with my previous findings that older directors will trade on their private information to compensate themselves for the forgone promotion-based incentives with lower aggressiveness. They did not place much implicit value on their future promotion opportunities because their career horizons are shorter. This finding is consistent with Gibbons and Murphy (1992).

Thirdly, I employ insider personal investment horizons to proxy for their career horizons to further confirm the *forgone incentives hypothesis*. Akbas, *et al.* (2020) show that short horizon (SH) insider sellers frequently reverse their previous buy positions to avoid overconcentrating their personal

portfolios on their firms. Consequently, these insiders have shorter career horizon in their firms. I hypothesise that SH sellers will trade on their private information with lower aggressiveness if they are motivated by the forgone CEO promotion because a shorter career horizon indicates a lower expected value for the forgone CEO incentives. I modify the investment horizon measure proposed by Akbas, *et al.* (2020) to identify SH sellers. I explain the details in Appendix 1. 2.3% (9.2%) of my insider purchase (sell) sample was executed by short-horizon insider sellers. The small number of observations in insider purchase sample indicates that SH sellers are less likely to make purchase transactions after they have lost the tournament.

I create short-horizon dummy variable $\text{SHD}_{\text{I,t}}$ equals to one for SH insiders, and zero otherwise. I employ $\text{SHD}_{\text{I,t}}$ as the moderator and report the results in Table 5 Panel C. The coefficient of $(\text{Post}\times\text{Treat}\times\text{SHD})_{\text{I,t}}$ is significantly positive in columns (3) and (4), suggesting that insiders who frequently unload their ownerships in their firms will trade on their private information with lower aggressiveness. Importantly, the sign and overall significance of the $(\text{Treat}\times\text{Post})_{\text{I,t}}$ remain consistent in all three panels with my previous findings, suggesting that insiders will incorporate more positive (negative) private information into their purchase (sell) transactions after controlling for their forgone incentives, pay rank and investment horizons[25].

[Insert Table 5 here]

I investigate whether *stock misvaluation hypothesis* plays a role in the insider trading decision, I employ two proxies to measure the stock informativeness: the Future Earnings Response Coefficient (FERC) proposed by Tucker and Zarowin (2006) and the return synchronicity suggested by Piotroski and Roulstone (2004). I explain the constructions of these two proxies in details in Appendix 1. For FERC, I create binary variable $\text{FERC}_{i,t}$ that is one for the top quintile of stocks whose current prices contain the most future earnings information and zero otherwise. As for return synchronicity, I create a binary variable $\text{Synch}_{\text{I,t}}$ that equals to one for the top quintile of stocks whose current prices contain less firm-specific information and comove strongly with the current and lagged market and industry returns, and zero otherwise. I then employ $\text{FERC}_{i,t}$ and $\text{Synch}_{\text{I,t}}$ as the second moderator variables separately. I hypothesise that when the firm's share price is less (more) informative for the firm-specific information, insider trading returns will be high (lower). The significance and the sign of the coefficient of $(\text{Treat}\times\text{Post})_{\text{I,t}}$ should be robust to the inclusions of these two firm information environment measures because insiders' motivation to trade is not only to correct the mispricing but to compensate themselves for the forgone CEO promotion opportunity.

[25] In unreported results, I also create dummy variable for sample after 2011, the year in which the unbinding Say-on-Pay law was passed. I did not find the implementation of Say-on-Pay law plays a significant result.

I find, but not report, that for the buy trades, the coefficient of $(\text{Post}\times\text{Treat}\times\text{FERC})_{I,t}$ is insignificant suggesting that insider purchase profitability after the CEO turnover is not affected by the level of stock price informativeness for future earnings, but, for the sell trades, it is positive and statistically significant, implying that insiders' sell transaction generate more negative returns when the current stock price reflects lower future earnings information in year 0. I also employ $Synch_{i,t}$ as the moderator variable. Although the sign and significance of $(\text{Treat}\times\text{Post})_{I,t}$ remain consistent, the coefficient of $(\text{Post}\times\text{Treat}\times\text{Synch})_{I,t}$ is statistically insignificant in all columns, suggesting that insiders' trading profitability does not depend on the level of co-movement between current firm return and the current and lagged market and industry returns, i.e., when stock price contains firm-specific information. The results are in Appendix 5.

In conclusions, the significant roles of age, historical pay rank and personal investment horizon further lend stronger support to the *forgone incentives hypothesis*. The motivation behind insider sell transactions in the year $(0,1)$ is not necessarily to trade on stock mis-valuation but mainly to seek profit to compensate themselves for the loss of the CEO compensation.

Informational content embeds in insider transactions

I examine the information content of insider trading after losing the CEO competitions to confirm that these more informed insider transactions are not driven by the unobservable firm characteristics. I focus on three non-mutually exclusive possibilities; insiders may trade on future operating performance changes, exploit the change in investor sentiments and base on the future change in the cost of capital. I compute the 2-year change in ROA from $(t, t+2)$with year *t* being the insider transaction year to estimate the former, denoted as ΔROA[26]. I explain the constructions of the change in investor sentiments and change in the cost of capital in details in Appendix 1. To measure the change in investor sentiment denoted as $\Delta Sentiment$, I compute the market-to-book ratio decomposition of Rhodes–Kropf, Robinson and Viswanathan (2005). Cziraki *et al.* (2021) argue the method can separate the firm-specific sentiment from industry-level sentiment and is appealing to insider trading studies because insiders are more likely to possess private information on the former than on the latter (Wang, 2019). I follow Cziraki *et al.* (2021) to measure the change in sentiment $\Delta Sentiment_{t-1,t+1}$ between $(t-1, t+1)$ with year *t* as insider trading year. To measure the change of cost of capital $\Delta r_{t,t+2}$, I estimate the following modified Fama and French (1993) three-factor model by following Cziraki, *et al.* (2021). I re-estimate the difference-in-difference regression by separately substituting $\Delta ROA_{t,t+2}$, $\Delta Sentiment_{t-1,t+1}$ and $\Delta r_{t,t+2}$for the dependent variable BHAR_m_365. I control the same set of control variables and report the regression results in Table 6.

[26] My results remain robust if I use the change in ROA from $(t, t+1)$ with insiders trade in year t.

Panel A, where the dependent variable is $\Delta ROA_{t,t+2}$, shows that insider sell transaction can significantly predict a decrease in ROA in the next three years. Insider sell transactions predict a 2%, and 1.1% decrease in $\Delta ROA_{t,t+2}$ in year 0 and 1, respectively, unlike insider purchase transactions as column (1) and (2) show that $(\text{Post}\times\text{Treat})_{\text{I,t}}$ is not significant. Similarly, in Panel B, where the dependent variable is $\Delta Sentiment_{t-1,t+1}$, insider purchase transactions do not significantly predict future investor sentiment change in year 0, while insider sell transactions in years 0 and 1 predict a 5.4% and 6.2% additional decrease in the firm's market value that is not explained by fundamentals. In Panel C, $\Delta r_{t,t+2}$ is the dependent variable. I can observe that insider purchase sample does not predict the future decrease in the cost of capital in year 0 whereas insider sells predict 0.1% increases in the cost of capital in both year 0 and 1. The coefficient of $(\text{Post}\times\text{Treat})_{\text{I,t}}$ is statistically significant at the 95%, and 90% in column 3 and 4, respectively. Overall, these results highlight that the higher return predictability embedded in the insider sell transactions is not random. Insiders exploit the worsening in future firm performance, the lower investor sentiment, and an increase in the future cost of capital to yield more negative return in sell transactions, and there is no clear result for insider purchases.

[Insert Table 6 here]

Insider trading and the effect of the tournament incentives

My previous results imply that directors consider their trading opportunities as a means to compensate themselves for the forgone promotion-based incentives (Roulstone, 2003). Nevertheless, if the tournament incentives truly play an important role in the insiders' information set, they can also trade on their private information prior to the tournament if the expected gain outweighs the associated litigation risk. One additional implication implied from my result is that the insider trading opportunity weakens the tournament's incentive effect because the tournament prize is not as high as it appears. After all, directors always have outside options to trade on their private information. In this section, I revisit the empirical finding in Kale *et al.* (2009) by considering insider trading activity as an additional factor to consider and investigate whether the presence of insider trading opportunity weakens the positive effect of tournament incentives on firm performance.

To measure the total non-CEO insider trading activity, I construct the variable $all\_IT_{j,t}$ which is the total number of insider transactions executed by non-CEO directors for firm *j* in year *t*. The higher $all\_IT_{j,t}$, the more prevailing the insider trading activity in firm *j*. Furthermore, I use the following refined fixed effect regression version of Kale *et al.* (2009) to proxy the firm performance using Tobin's Q and ROA.

$$\begin{aligned}\text{firm\_performance}_{\text{j,t}} = \alpha &+ \beta_1 \text{pay\_gap}_{\text{j,t}} + \beta_2 \text{rd}_{\text{j,t}} + \beta_3 \text{sale}_{\text{j,t}} + \beta_4 \text{sale}^2_{\text{j,t}} + \beta_5 \text{capital-to-sale}_{\text{j,t}} + \\ &\beta_6 \text{advertising-to-sale}_{\text{j,t}} + \beta_7 \text{dividend-yield}_{\text{j,t}} + \beta_8 \text{leverage}_{\text{i,t}} + \\ &\beta_9 \text{lnage}_{\text{j,t}} + \rho + \delta + \varepsilon_{\text{i}} \qquad (6)\end{aligned}$$

where $pay\_gap_{j,t}$ is the proxy for tournament incentives as previously specified. ρ represents firm fixed effect, and δ is year fixed effect. The standard error is clustered at the firm level. The remaining variables are defined in Appendix 3. $Pay\_gap_{j,t}$ represents the tournament incentives, and β_1 should be statistically significant and positive according to Kale *et al.* (2009) because the higher tournament incentives, the better the firm performs. Remarkably, Kale *et al.* (2009) did not correct the CEO compensation figure for the FASB 123R revision. Therefore, my proxy for the tournament incentives is not constructed exactly as Kale *et al.* (2009).

To investigate the effect of insider trading activity on the tournament incentives, I follow Kale *et al.* (2009) to estimate a 2SLS regression with two first-stage regressions. Kale *et al.* (2009) applied the median value of tournament incentives for firms in the same sales quintiles and the same two-digit SIC industry as the firm as their instrumental variable because it is a significant determinant of the size of each firm's tournament incentives. In addition, the level and structure of managerial compensation vary by industry and firm's size, which is proxied by sales. Since the tournament incentives depend on the compensation structure within an organisation, the median value of tournament incentives in the same size and industry is a natural choice for the IV. My second stage regression is as follows:

$$\text{firm\_performance}_{j,t} = \alpha + \beta_1 \widehat{\text{pay\_gap}}_{j,t} + \beta_2 \widehat{\text{pay\_gap} \times \text{all\_IT}}_{j,t} + \beta_3 \text{all\_IT}_{j,t} + control + \varepsilon_i \qquad (7)$$

If the positive relationship between the tournament incentives and the firm performance is weakened with the presence of high insider trading activity, β_2 will be negative and statistically significant. The above regression specification implicitly assumes $all\_IT_{j,t}$ is exogenous. One obvious source of endogeneity is reverse causality as expect insiders may purchase (sell) more in outperforming (underperforming) firms as they understand their firms' future valuation. Thus, simply using one IV for the tournament incentives is not sufficient to conclude the causal relations.

I relax the assumption that $\text{all\_IT}_{j,t}$ is exogenous, by using an additional IV to proxy for $all\_IT_{j,t}$. I follow Kim and Lu (2011) and use the sum of maximum state and federal marginal personal income tax rates (hereafter called tax rate) as my second instrumental variable. Kim and Lu (2011) argue that personal income taxes may affect the personal portfolio composition and the timing of stock transactions and option exercises and directors in a high tax state may prefer tax-exempt securities to stock more than directors in a low tax state, ceteris paribus, thus causing lower stock ownership. In the same vein, the tax change may also lead to a change in share ownership as directors may sell (hold) more shares when they anticipate a tax increase (decrease). Moreover, the variation in state tax laws across states and years is exogeneous to a firm's future performance. Kim and Lu (2011) also employ Tobin's Q to proxy for firm performance in the second stage of their 2SLS regression. I collect the sum of maximum state and federal marginal long-term capital gain tax rates from Feenberg and Coutts

(1993)[27]. Taxpayers, including corporate insiders, are subject capital gain tax on any capital return from trading stocks. The tax rate, available from 1997 until 2019, assumes a married representative taxpayer with joint filing and in top tax bracket in her state. Kim and Lu (2011) show that a higher tax rate will cause the CEO to reduce their stock ownership holdings to lessen her expected capital gain. In the same vein, I hypothesise that a higher tax rate will lead to a lower insider trading activity as any capital gains directors obtain from their trades will be taxed more heavily, reducing their propensity to trade.

Table 7 reports all results. For brevity, I omit the first-stage regression result and report only the first-stage F statistics. In column (1) and (2), I replicate the finding in Kale *et al.* (2009). The coefficient of $pay\_gap_{j,t}$ is positive and statistically significant at the 99% confidence level in both columns, indicating that tournament incentives' positive effect on the firm performance persists in my sample period. In column (3) and (4), I employ the median industry tournament incentive as the IV and interact the insider trading intensity with the predicted tournament incentive. The coefficient of $\widehat{pay\_gap}_{j,t}$ is positive and statistically significant at the 99% and 90% confidence level in column (3) and (4), respectively. The result further highlights the finding in Kale *et al.* (2009) that there is a causal relationship between tournament incentives and firm performance. A higher pay disparity between the CEO and other directors will motivate them to exert higher effort to compete for the next CEO position and consequently improve the firm performance. More importantly, the interaction terms' coefficient is negative and statistically significant at the 99% confidence level in columns (3) and (4). The results are consistent with my previous findings that insider trading opportunity weaken tournament incentives' positive effect on the firm performance.

In column (5) and (6), I employ the tax rate as my IV to predict the number of insider transactions $all\_IT_{j,t}$, I omit the first-stage regression output for brevity. I report Sanderson-Windmeijer F statistics which tests the null hypothesis of under-identification of each endogenous variables because I have three endogenous variables in the first stage regression. These test results show that all three endogenous variables are identified. The Sanderson-Windmeijer F-statistics is marginally below 10 for $all\_IT_{j,t}$. In an unreported result, I separately check the explanatory power of tax rate on insider trading transactions by including the tax rate as the only IV to explain the $all\_IT_{j,t}$ in the first-stage regression. The tax rate coefficient is negative and statistically significant at the 99% confidence level with 11.4 first-stage F statistics[28], meaning a higher tax rate is associated with fewer insider transactions. In column (5) and (6), the coefficient of $\widehat{pay\_gap}_{j,t}$ is positive and statistically significant at the 95% confidence level in both columns, in line with Kale *et al.* (2009), and the interaction term's coefficient is negative and statistically significant and its magnitude is around a third of the coefficient of $\widehat{pay\_gap}_{j,t}$, suggesting

[27] I thank Dr Feenberg for updating these data regularly and making these data publicly available. https://users.nber.org/~taxsim/state-rates/

[28] Stock and Yogo (2005) weak identification test also support my conclusion that the tax rate can explain the variation in insider transaction number.

that the tournament incentive's effect on firm performance will be overestimated by a third if the possibility that directors can realise their implicit promotion-based compensations by trading on their private information is overlooked. The coefficient of $\widehat{all\_IT}_{j,t}$ is also positive and statistically significant, suggesting that more insider trading transactions improve firm's performance, mitigating he agency problem by aligning directors' interest with shareholders (Manne, 1966). Overall, I provide strong evidence to show that the positive effect of tournament incentive on firm performance is weakened with the insider trading opportunity. Moreover, these results reaffirm that insiders will consider their unrealised promotion prize when they make transactions, consistent with my previous findings.

[Insert Table 7 here]

IV. Robustness Test

Reverse causality concern

The results so far indicate a systematic increase in non-promoted directors' trading profitability after losing the CEO promotion, which is primarily driven by their forgone tournament incentives. However, it is possible that tournament competitors systematically avoid trading on their private negative information when competing for the CEO position in year (-2, -1) because their trading decisions may adversely affect their winning probabilities because sells would be seen as a lack of belief in the firm. In the same vein, insiders who frequently trade on their private information may have lower probability to be promoted to the CEO position. The possible reverse causality will induce endogeneity and further questions my results. I argue that it is applaudable to assume the occurrence of the non-CEO director transactions will not affect the outcome of CEO turnover. Legal insider trading is pervasive in the stock market since 80s, and therefore firms widely accepted that insiders trade on their private information to complement their compensation packages (Roulstone, 2003).

To further reaffirm that my results are not affected by the potential endogeneity, robust to the alternative estimation method and do not hinge on the underlying matched sample, I estimate the 2SLS using the last fiscal year's former CEO age as my IV based on the universal sample to generalise my results outside the tournament period. I compare non-promoted directors' transaction profitability with their unconditional return to investigate whether their post-tournament transaction return is significantly different from their transaction returns outside a CEO turnover event when the CEO tournament has not begun. I focus on the isolated CEO turnover and exclude transactions in year +2 to have a cleaner sample with no confounding events to be consistent with diff-in-diff regression, but my result is robust to its inclusion. In the robustness test, I further conduct a test on the predictive power of insider trading on tournament outcome to further alleviate the reverse causality concern.

Table 8 reports the results excluding the control variables for brevity. The coefficients of $age\_ceo_{I,t-1}$ in all first-stage regressions are statistically significant with the expected signs, indicating

$age\_ceo_{I,t-1}$ is an appropriate instrumental variable for CEO turnover event. It is positive and statistically significant in column (1) and (3), suggesting that the older the former CEO, the higher the likelihood of a CEO turnover in the next fiscal year, in line with my hypothesis. For periods (1,1) in columns (2) and (4), the coefficients of $age\_ceo_{I,t-1}$ become negative and statistically significant, suggesting that the recently left CEO is younger than the average former CEO age among all firms covered by Execucomp. I report all the test statistics related to the endogeneity and IV validity in Table 8's bottom panel in all five columns. The first stage F statistics are all above 10, which is the minimum value to alleviate the weak instrument concern[29], providing significant support for the relevance condition. The Anderson-Rubin F-statistic rejects the null hypothesis and indicates that the endogenous regressor $NPED_{I,t}$ is statistically significant. The result indicates insiders indeed incorporate more private information embedded into their transactions after losing the CEO competition. The Anderson-Rubin F-statistic is robust to the presence of weak instrumental variable (Andrews, Stock and Sun, 2019) and thus reaffirm my findings. In unreported result, I also check for a potential weak instrument using the Stock and Yogo (2005) test and the Shea Partial R-squared values, and I find that my IV does not suffer from weak instrument problem throughout the study. The Difference-in-Sargan *C*-statistic rejects the null hypothesis that the $NPED_{i,t}$ is exogenous to the insider transactions abnormal return. Since I have only one endogenous variable and one instrumental variable, the *Difference-in-Sargan C-test* is equivalent to a *Hausman* test comparing 2SLS estimates with fixed effect (FE) estimates. The significant *C*-statistics confirm the necessity of applying 2SLS rather than the FE estimator.

In the second-stage regression for insider purchase sample, I report the regression results without the $NPED \times CEO\_IT_{I,t}$, which is insignificant in unreported results, for year 0 and +1 in column (1) and (2), respectively. The insignificance of the interaction term highlights that when non-promoted directors make purchase transactions, they do not consider the current CEO trading activity. The coefficient of $\widehat{NPED}_{i,t}$ is positive and statistically significant in column (1). The results indicate that every 1% increase in the probability of the occurrence of CEO turnover event in year 0 leads to a 0.626% increase in the BHAR_m_365. The results are consistent with my diff-in-diff regression result that insider who lost the CEO competition incorporate more positive private information into their purchase transactions. The losing tournament effect for insider purchase sample only exists in the year of losing CEO competition, not one year afterwards. Furthermore, the coefficients of $OutsiderD_{I,j}$ is negative, statistically significant and in the opposite sign to the coefficient of $\widehat{NPED}_{i,t}$ in year 0. These negative

[29] Notably, first stage F-statistics are all relatively large for my insider sell sample. These large F-statistics are caused by the large sample size, the two fixed effects and/or the high predictive power embedded in my IV for my endogenous variable. If there is high predictability between my IV and endogenous variable, then there will be a very little amount of exogenous variation left for the second-stage regression. To address the concern, I separately estimated all the first-stage regression and checked the within R-squared whenever the first stage F-statistics is larger than 200 in my study. After applying the firm and month fixed effects, the within R-squared in the first-stage regression is generally around 0.4. Thus, I reckon my IV is suitable.

coefficients suggest that when the insiders incorporate more private positive information into their purchase transactions, the purchase transactions executed by insiders from firms that hired an outsider CEO will trade on their private information with relatively lower aggressiveness.

In column (3) to (4), I focus on insider sell transactions which contain severer endogeneity than insider purchase transactions because many insiders sell transactions are not undertaken to seek profit. The coefficients of $\widehat{NPED}_{i,t}$ are negative and statistically significant at the 95% and 99% confidence level in column (3) and (4), respectively. These results support my hypothesis that insiders incorporate more private negative information into their sell transactions to compensate themselves for the forgone promotion-based incentives. The interaction term's coefficient is positive and statistically significant for the insider sell sample in both year 0 and +1, indicating that insiders' sell trades systematically yield a more negative abnormal return when the newly appointed CEO increases her holding, consistent with my hypothesis that directors strategically time their sell transactions to trade against the current CEO. For an otherwise-average insider sell transaction, a 1% increase in the predicted probability of the transaction in year 0 will cause the BHAR_m_365 to decrease by 1.117%[30] and by 0.6% if the 1% increase is in year 0 and +1, respectively. The magnitude of $(\widehat{NPED \times CEO\_IT})_{I,t}$ is the largest in year 0, and further highlights that the CEO trading direction plays a more prominent role in the director's decision-making process in year 0 than in years 1.

The asymmetry effect of CEO trading activity proxied by $CEO\_IT_{I,t}$ in the insider purchase and sell sample is due to the asymmetric litigation risk associated with insider trading based on private information. Insiders sell based on negative private information involve higher litigation risks than purchase based on positive private information. Skinner (1994) argue that the insider purchase transaction will only lead to an opportunity loss, but the sell transaction is responsible for the out-of-pocket loss. An opportunity loss is more difficult to prevail before juries than an out-of-pocket loss. Therefore, directors will intentionally sell more shares to exploit their negative private information when the current CEO purchases more shares to prolong their tenures. These less informative CEO purchase transactions can distract the outsiders' attention and cover the directors' sell transaction because CEOs have higher public visibility and are subject to stricter market scrutiny (Sabherwal and Uddin, 2019). As a result, director's sell transactions, which are on average uninformative, will greatly benefit from the trading opportunities to reduce the litigation risk and incorporate more negative private information into their sell transactions.

Contrary, insider purchase transactions are associated with lower litigation risk, and insiders can trade relatively freely on their positive private information to reap monetary gains. Consequently, there is stronger return predictability based on firm-specific private information embedded in their

[30] 2.911-1.794=1.117

purchase transactions (Lakonishok and Lee, 2001). Insiders will not benefit greatly from trading against CEO's sell transactions to cover their purchase transactions. Thus, the interaction term is insignificant in unreported results for insider purchase sample. Moreover, the coefficient of $COOD_{I,j}$ is positive and statistically significant in year 1 for the insider sell sample, suggesting that non-promoted insiders from firms with a CEO successor prior to the tournament trade on their private negative information with less aggressiveness than their counterparts from firms that had not pre-assigned a CEO successor.

Overall, the diff-in-diff estimation results are in line with my hypothesis that non-promoted directors will make more informative purchase and sell transactions after losing the CEO promotion. The 2SLS results show insiders will incorporate more negative private information into their sell transactions in all post-event years, consistent with the diff-in-diff regression results. Additionally, I apply the 2SLS estimator with the same IV based on the matched insider sell sample. I display the regression result in Appendix 6. Like my previous finding, the last fiscal year's former CEO age remains a valid predictor for CEO turnover because the first stage F statistics are all above 10, highlighting that my IV's relevance condition is valid in the smaller sample. The signs and significance of the coefficient of $\widehat{NPED}_{I,t}$ are overall consistent with the 2SLS estimates obtained using the universal sample. Insiders incorporate more negative information into their sell transactions in all two post-event years. For the insider purchase sample, there are only 770 observations with a valid non-missing former CEO age. The coefficient is insignificant, and I omit the regression output.

Moreover, I focus on CEO turnover year (0,0) and estimate a linear probability model with firm and year fixed effects at insider-firm level. The dependent variable is a dummy variable equal to one for newly promoted CEO, and zero for other non-promoted directors who were competing in the turnover. The main variables with interests are the numbers of insider purchase and sell transactions in year -1 and year -2. If there is no reverse causality concern, the coefficients of the numbers of purchase and sells should be statistically insignificant. I control for director's age, tenure, total compensation, delta and vega and other firm-level characteristics all calculated at the end of year -1. If the director was either chief operating officer or president, the $COOD_{I,t-1}$ is equal to one, and zero otherwise.

Appendix 7 displays the result. The coefficients of $no\_buy_{I,t-1}$, $no\_sell_{I,t-1}$, $no\_buy_{I,t-2}$, $no\_sell_{I,t-2}$ are all statistically insignificant, highlighting that insider transactions before CEO turnover year bear little predictive power for CEO promotion probability. In an untabulated result, I additionally control for director and year-industry fixed effects or estimate the regression at the insider-transaction level, all my results remain robust. These results rule out the possibility reverse causality concern

Insider sequential sell transactions around dissimulation strategy

Huddart, Hughes and Levine (2001) argue that the implementation of the U.S security law will increase the market scrutiny of insiders' transactions and reduce insider dealing profitability by strictly

regulating corporate insiders to disclose their transactions two days after execution publicly. Despite a potential lessening of their returns by as much as a half because of the improved market efficiency, trading on private information remains a profitable strategy for insiders. Consequently, profit-maximizing insiders who actively materialize their private information have incentives to dissimulate their private information by randomly trading in a manner inconsistent with their informational agent role. If their private information is long-lived,[31] they will intentionally make noisy transactions to thwart outsiders who intend to follow them.

In the same vein, Kose and Ranga (1997) model that insiders can maximise their expected gains by randomly mixing sell transactions with uninformative purchase transactions to dissimulate the private information they exploit. Biggerstaff *et al.* (2020) report that insiders incorporate their private negative information into multiple sell transactions to minimise the price impact. They define sequential sells as sell transactions executed at most 30 days apart and show that the return of the last transaction in a sequence is more negative than the isolated sell transaction on average. The dissimulation strategy is only effective to disguise the negative private information embedded in sell transactions, not the positive private information embedded in purchase transactions.

Inspired by these results, I test whether the losing tournament effect persists after accounting for the possibility that insiders intentionally split their private negative information into many sell transactions and randomly mix with purchase transactions. I define transactions are in the same sequence when they are executed within ten calendar days[32]. When a sequence contains both purchase and sell transactions, I aggregate the trading value to compute the sequence's trading direction. If the total value is negative, all transactions in the sequence are defined as sequential sells. Other sell transactions not in a sequence are isolated sells.

Furthermore, I adjust the BHAR_m_365 for all transactions in a sequence using either the BHAR_m_365 from the last transaction in a sequence or extending the holding period from the beginning to the 365 calendar days after the last transaction. I implicitly assume insiders will close all her positions 365 days after the last transaction. In un-tabulated univariate statistics, 48.9% of all sell transactions are identified as sequential sell transactions. A typical sell sequence will last for 23 days, consists of 8 transactions on average. Out of these sequential sells, only 7% contains both purchase and sell transactions. The result is expected because the short-swing rule prevents insiders from realising profit from two off-setting transactions in the first six months after the first transaction. All my results are robust if I remove purchase transactions and solely focus on sequence consists of sell transactions only. I re-estimate Equation (5) with the adjusted BHAR_m_365 based on all sequential and isolated sell transactions. In un-tabulated results, I substitute the BHAR_m_365 from the last transaction in a

[31]Insiders with short-lived information cannot adopt this strategy because the information will soon be revealed to the market.

[32] My results remain robust if I extend the horizon to 15 and 30 calendar days.

sequence for all sequential transactions in the same sequence. The coefficients of $\widehat{NPED}$ are negative and statistically significant, providing further robustness to my results. Furthermore, I extend the holding period for sequential sells from 1 day after the first transaction to 365 days after the last transaction. Because the holding horizon varies depending on the sequence length, I compute the daily average BHAR_m_365×252, the median number of trading days in a 365-calendar day holding period. I report the coefficients of $\widehat{NPED}$ in Table 8 Panel B. My overall results remain unchanged, but the coefficients of $\widehat{NPED}$ become more negative than Table 8 in all two post-event years for sells, implying the losing tournament effect is stronger after controlling for insider dissimulation strategy.

[Insert Table 8 here]

Additional tests for IV exclusion restriction

One of the main assumptions behind my results is that my IV, the last year former CEO's age, is not correlated with the private information that non-CEO directors are exploiting. The former CEO's age *per se* will not affect a firm's valuation as it bears no impact on the firm's future cash flow, but I recognise the possibility that former CEOs may affect her firm's future valuation through the adaption of corporate decisions with long-lasting effect. Although there is no reason to believe that the preference for a long-last policy is systematically related to director age, this possible violation of exclusion restriction will lead to an inconsistent estimate, weaking my conclusions. I alleviate this potential concern is by including a set of proxy variables for corporate performance in my 2SLS regression.

In the first robustness test, I include fourteen additional control variables that embed predictive power for the firm's future fundamental and are possibly determined by the personal preferences of CEOs in different age groups. By conditioning on these channels, I can better demonstrate the validity of the exclusion restriction and the robustness of my results. Appendix 3 presents the construction of all variables. I include $tobin's\ Q_{I,t-1}$, $capital\text{-}to\text{-}sale_{j,t-1}$, $advertising\text{-}to\text{-}sale_{j,t-1}$, $capital\_intensity_{I,t-1}$, $leverage_{I,t-1}$, $dividend\text{-}yield_{j,t-1}$ to control for firm level characteristics. I compute the segment sales-based Herfindahl index denoted as $firm\_focus_{I,t-1}$ to control for firm diversification. I include $cash\_flow\_vol_{I,t-1}$ and $skt\_ret\_volatility_{I,t-1}$ to control for firm risk taking incentives, and $institution\_ownership_{j,q-1}$, $independent\_director_{j,t-1}$ and $independent\_committee_{j,t-1}$ which is the proportion of independent directors on the compensation committee to control for corporate governance. Additionally, I control for the natural logarithm of the current age of non-CEO directors denoted as $lnage_{j,t}$. I include these control variables in addition to the original set of control variables in Equation (5) to get a comprehensive set of variables to filter out all the possible indirect channels that the CEO's age may affect the firm's future valuation and run the 2SLS regression in the section[33]. I follow Dang

[33] All my results remain robust if I include the contemporaneous values of these additional control variables instead of their lag one value

et al. (2021) to control for industry-level informativeness and include $analyst\_talent_{j,t-1}$ to proxy for the average talent of sell-side analysts following the firm *j* in the last fiscal year[34]. Dang *et al.* (2021) show that the talent of analysts will significantly lower the insider trading profitability. If my previous results are robust, I expect the sign and significance of my previous results are not changing with these variables' inclusion. Lastly, I include $CEO\_tenure_{j,t-1}$ to control for the tenure of CEO in the last fiscal year to show that my IV is not simply capturing the current CEO tenure. Table 9 Panel A reports the result. My sample size decreases by 54%, for the buy trades in column (1) by 30% for the sell trades in columns (3) to (4) because of data unavailability. I report the results for the insider purchase sample without the interaction term $\widehat{NPED \times CEO\_IT_{I,t}}$ which is insignificantly throughout the study. In column (1), the coefficient of $\widehat{NPED_{I,t}}$ is 1.448 and statistically significant at the 95% confidence level. In an un-tabulated result, I remove these additionally control variables one by one and the statistical significance of the coefficient of $\widehat{NPED_{I,t}}$ increases monotonically with my sample size while remaining positive. I report results for insider sell samples in column (3) to (4). Overall, the sign and significance of $\widehat{NPED_{I,t}}$ and $\widehat{NPED \times CEO\_IT_{i,t}}$ are consistent with my previous results. In un-tabulated results, I also include the $tobin's\ Q_{I,t-I}$, $capital\_intensity_{I,t-I}$, $leverage_{I,t-I}$, $dividend\text{-}yield_{j,t-I}$, $roe_{j,t-I}$ and $rd_{j,t-I}$ at the end of the year that the former CEO left the company, all my results remain robust.

As the second robustness test, I consider that former CEO's age will only affect non-CEO's trading profitability through CEO turnover. Therefore, if I regress the BHAR_m_365 on former CEO's age by using years other than year 0 and year 1, the coefficient of CEO's age should be statistically insignificant if the exclusion restriction holds. In un-tabulated results, I re-estimate the regression in Table 8 by substituting the former CEO's age for the $\widehat{NPED_{I,t}}$ with the same set of control variables, and confirm that the coefficient of the former CEO's age is statistically insignificant for both insider purchase and sell samples, strengthening the plausibility of exclusion restrictions further. Additionally, I recognise that some firms retain their former CEOs on the board after these CEOs have left the role. I argue the possible retention does not affect the irrelevance condition because Evans, Nagarajan and Schloetzer (2010) show that the CEO retention does not affect firm's future stock return, and only 11.67% of my insider trading sample was made in a CEO retention year. Nevertheless, I replicate our 2SLS regression by excluding all insider transactions in the post-event period if their firms retain the former CEO after the turnover. I lost 5% (2.6%) of insider purchase and 3.8% (2.6%) of insider sell in year 0 (year 1), respectively. In unreported results, all my conclusions remain robust.

Other robustness tests

In the third robustness test, I refine my year *0* sample into the transactions-day level. I have shown that directors are more likely to incorporate more positive (negative) private information into

[34] I are grateful to Dr. Li for making the analyst talent data available.

their purchase (sell) transactions in year 0. The conclusion hinges crucially on the assumption that I do not mis-specify the insider transactions prior to the tournament outcome as post-tournament transactions. I rely on Execucomp item *becomeceo* to identify the specific date for the CEO turnover. Jenter and Lewellen (2021) report that Execucomp reports wrong CEO turnover dates *becomeceo* for several CEO turnover events. I first manually check all the CEO turnover date reported by Execucomp. For the *becomeceo* date that is one calendar year apart from the fiscal year, I manually check and correct it by cross-checking BoardEx. I reclassify the transactions before the succession of the new CEO as pre-tournament transactions and re-estimate Equation (5). In an un-tabulated result, the coefficient of $\widehat{NPED}_{I,t}$ is 0.733 and -3.078 and is statistically significant at the 90% and 95% confidence level for insider purchase and sell samples in year 0, respectively.

Furthermore, I check my results' robustness using alternative holding periods and using four-factor alpha as an alternative measure of abnormal return. In addition to the 365-calendar day holding period, I also focus on the 30-day and 180-day holding periods. I use Kenneth French's Data Library[35] to gather the Size, Value, Momentum factors, risk-free rate to compute the alpha from Carhart (1997)'s Four-Factor model, which builds on the Fama-French Three-Factor model (Fama and French, 1993) as follows:

$$return_{it} - rf_t = \alpha + \beta_1(MKT_t - rf_t) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \epsilon_t \quad (8)$$

α, the risk-adjusted return is estimated from one day after the transaction date over the next 30/180/365 calendar days. $return_{i,t}$ it is the daily return adjusted for dividend, rf_t is the risk-free rate proxied by the one-month T-bill rate. MKT_t is the CRSP value-weighted market index. *SMB/HML/MOM* denote the conventional size, book-to-market, and momentum factors. I time the daily α by the median number of trading days of 22, 126, 252 in these three holding periods, respectively. Additionally, I report the raw cumulative return $ret_{t+1,t+i}$ and the NYSE value-weighted size-decile adjusted return BHAR_size_i. Table 9 Panel B reports the coefficients of $\widehat{NPED}_{I,t}$. In column (1) to (2), I focus on insider purchase sample without the interaction term $\widehat{NPED \times CEO\_IT}_{I,t}$ which is insignificant throughout the study. The regression specification is the same in Equation (5). From these results, I can observe that coefficients of $\widehat{NPED}_{I,t}$ is insignificant in all holding horizons regardless of the measure of abnormal return. There is a discrepancy between the risk-adjusted return and BHAR at the 365-day holding period in year 0. In column (3) to (4), I focus on insider sell sample. The coefficient of $\widehat{NPED}_{I,t}$ is negative and statistically significant in the 180-day holding period in the post CEO tournament event window for all alternative measures, except for the 180-day holding period in year +1 when the return is measured by four-factor

[35] https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. I thank Professor French for making these data publicly available.

alpha. The remaining coefficients obtained using all alternative measures are consistent with the previous results.

The fourth robustness test investigates the probability that the increase in insider trading profit is solely driven by performance-induced turnover or planned succession. To proxy for the performance-induced turnover, I create underperforming dummy variable equals one for the bottom quintile of firms divided by using the raw annual stock return in the last fiscal year in the same two-digit SIC industry among all S&P 1500 firms, zero otherwise. I follow the same specification in Equation (5) with the additional underperforming dummy as the moderator. In an un-tabulated result, the interaction term between the underperforming dummy variable and $\widehat{NPED}_{I,t}$ remains statistically insignificant in all post-event years for both buy and sell samples, suggesting that performance-induced turnover does not drive my results.

The fifth robustness tests the validity of my diff-in-diff regression results over a $(-2,+1)$ period around pseudo-CEO turnovers which are arbitrarily set as three years before or after the actual CEO turnover. I use the same pair of treated and matched firms obtained early in the study but remove the firms that had a CEO turnover in the pseudo-event window. I re-estimate Equation (2), the regression results are omitted for brevity. In unreported results, I find the coefficient of the interaction term $\text{Post}\times\text{Treat}_{\text{I,t}}$ remains statistically insignificant for both insider purchase and sell samples, supporting the validity of the parallel trends assumption and the credibility of my diff-in-diff design.

Finally, to confirm my findings are not due to unobservable market, firm conditions. I re-estimate Equation (5) using 1,000 placebo tests for insider purchase and sell samples separately. Although the use of 2SLS estimator has greatly eliminated the probability that my results are obtained due to chance, I conduct the placebo tests to reaffirm the robustness of my results and my IV validity. Each test entails randomly selecting 400 firm-year observations with at least one insider purchase transaction and 1,600 firm-year observations with at least one insider sell transaction to be considered as CEO turnover year for insider purchase and sell sample, respectively. These two numbers are the nearest hundreds for the actual number of distinct CEO turnover firm-year observations, which is 386 and 1,601 in year 0 for purchase and sell samples, respectively. I remove the firm-year observations with actual CEO turnover event and the following two years from my sample. For each of the firm-year observations, I match the insider trading transactions in the given year and set $NPED_{I,t}$ to be one for all insider transactions in the year. I replicate Equation (5) without $\text{OutsiderD}_{\text{I,t}}$ and $\text{COOD}_{\text{I,t}}$and report the coefficient of $\widehat{NPED}_{I,t}$ and the first-stage F statistics in Table 9 Panel C. If my results are due to chance or unobservable factors, a relatively large proportion of my placebo tests report will have a higher first-stage F statistics and the coefficients of $\widehat{NPED}_{I,t}$ will be statistically positive (negative) for insider purchase (sell) sample, respectively. Column (1) of Table 9, Panel C shows that, the mean coefficient for the insider buy sample is statistically indifferent from zero. The distribution of coefficient of $\widehat{NPED}_{I,t}$

is right-skewed. For the insider sell sample, the mean coefficient is positive and statistically insignificant with a right-skewed distribution. On the right-hand side of the panel, I report the percentage of the placebo sample that has both a positive (negative) significant coefficient of $\widehat{NPED}_{I,t}$ and a first-stage F-statistics larger than 10 for insider purchase (sell) sample. There is no single test for insider purchase samples with both a significant positive coefficient and a valid first stage F-statistics. Out of 1,000 placebo tests for insider sell sample, there are only 8 cases that report a significantly negative coefficient of $\widehat{NPED}_{I,t}$ and an F-statistics larger than 10. Relying on a one-sided binomial test-statistic, none of the proportions is statistically different from the corresponding theoretical levels of 1%, 5% and 10%. There are 34 tests for insider sell sample report a first-stage F-statistics larger than 10 with a maximum of 19. In Table 10, my first-stage F is generally larger than 100, indicating my IV will not randomly be significant, and it does not contain predictive power outside CEO turnover event. I also conduct 1,000 placebo tests for my diff-in-diff regression. I first randomly select 1,000 firm-year observations without CEO turnover and is also not in any CEO turnover window. These firms are assumed to be treated firms. I then match the treated firms with one control firm with placement in the same year *t* based on the *t-1* average insider purchase/sell profitability, logarithm of the total asset and the book-to-market ratio. The year *t* is assumed to be the event year, and I estimate a diff-in-diff regression by using the observations of matched sample for year (t-2, t). I conduct placebo tests for insider purchase and sell samples separately and I restrict the treated firm cannot match to itself in the last year. I report the placebo test results in Table 9, Panel D. The average coefficient of the interaction term is negative (positive) for insider purchase (sell) sample. In column (5) to (7), I report the percentage of placebo tests with statistically significant and positive (negative) coefficient for purchase (sell) sample. Like the results in Panel C, none of the proportions is statistically different at any significance level based on a one-sided binomial test-statistic.

Additionally, it has been empirically documented that CFO is less likely to become the next CEO because these two roles required different skills (Goodman, 2010), and only 5% of the new CEOs in my sample period previously served as CFO in their companies. To test that my results were not driven by CFO trading, I removed all CFO transactions in my pre-turnover window which accounts for 9% of both the insider purchase and sell transactions sample. In unreported results, I re-estimate the Table 4 and the coefficient of $(\text{Treat}\times\text{Post})_{i,t}$ for insider sell in year +1 becomes weakly significant at the 90% confidence level, and the sign and significance of all other results remain robust. I further drop 10% observations within year $(-2, 1)$ from firms with a COO prior to the CEO turnover and re-estimate both the diff-in-diff and 2SLS regression, all my results remain robust.

Overall, these results indicate that my main findings obtained from both diff-in-diff regression and 2SLS cannot be replicated using a randomly selected sample of firms without CEO turnover events. The placebo tests further indicate that my IV is only relevant to explain years close to the CEO turnover, and it is extremity unlikely that I will obtain a significantly positive (negative) $\widehat{NPED}_{I,t}$ while satisfying

my IV relevance condition. The average insider transaction profitability embedded in purchase (sell) transactions will unlikely increase (decrease) without a CEO turnover. In conclusion, my previous results survive a battery of robustness tests.

[Insert Table 9 here]

Non-promoted director future promotion opportunity and sample selection

I recognise that the non-promoted directors may stay with the firm after losing the CEO competition because they target other higher-ranking positions within the firm. If the more senior position offers them an attractive increase in the salary, these directors may not have incentives to compensate themselves for the forgone CEO promotion. Nevertheless, I recognise the possibility is trivial because Execucomp mainly reports the top four highest-paid directors whose career path is already at the top of the corporate hierarchy in addition to the CEO. Therefore, any increase in their compensation package will not be as significant as the CEO promotion reward. To investigate this possibility, I focus on the isolated CEO promotion event not followed by another CEO tournament window in the next six years, i.e., where there is only one CEO turnover from year 0 to year 7. I use the same restriction to calculate the pay rise for directors' total compensation package with the absence of CEO turnover. I further rank directors by their total compensation package in their firms after excluding CEO and directors who are not competing for the CEO position. For example, if a director's pay rank is 1, her total compensation package is the highest among all CEO competitors. Finally, I compare their pay rank and total compensation package between year -1 and year 4.

In unreported results, I find non-promoted director's pay rank decreases by 1.4 from year -1 to year 4, with year 0 as the CEO turnover year. The pay rank decrease is 0.6 in the same 5-year period without losing CEO turnover. The difference is statistically significant at the 99% confidence level. To further understand the dollar value of the faster promotion speed, I compute the difference in total compensation package between years -1 and 4. I find non-promoted directors will receive a $0.73 million pay rise in a 5-year time after losing the CEO turnover. They will normally receive $0.57 million pay rise in the same period if they have not lost the CEO competition. The $0.16 million difference is statistically significant at the 95% confidence level. Directors who were the 4th highest paid among all CEO candidates in year -1 have relatively more promotion opportunities than directors who were the highest-paid non-CEO directors. These directors receive a $0.73 million pay rise if they lose the CEO competition, $0.25 million higher than that $0.48 million they normally receive in a five-year time. Insiders who were the top three highest-paid directors before losing the CEO promotion do not receive any significant additional pay rise in the next 5-year period. Non-CEO director's total compensation package is $1.86 million in year -1, and the newly appointed CEO's average total compensation package in the year 0 is $5 million, the additional $0.16 million pay rise in five years is unlikely to weaken their incentives to compensate themselves for the forgone CEO promotion opportunity.

I further estimate a fixed effect regression with director, firm and year fixed effects. The dependent variable is the change in the natural logarithm value of the total compensation in one or two-years' time, and the main variable with interest is a dummy variable that equals to one for year (0,4) and zero otherwise. I control for director's age, tenure, delta and vega, firm's size, leverage, book-to-market ratio, return on asset and Tobin's Q. In unreported results, I find that there is no significant change in the total compensation of non-promoted director in both one and two-years' time after they have lost the CEO promotion. These results are consistent with Kale, *et al.* (2009) and Chan *et al.* (2019) that show the tournament losers are not compensated for the dimmer career prospects.

V. Conclusion

Corporate directors' remuneration contracts consist of both the explicit payment component such as annual salary, bonus and the implicit promotion-based component that provides them with the promotion opportunity and the chance to receive the salary rise accompanies the higher job position known as the tournament incentive. For the high-rank directors, their only promotion destination is the CEO position. If their CEO promotion is not successful, the likelihood of winning the CEO competition in the future is drastically lowered if not forgone completely. Consequently, the overall value in her remuneration contract is lower because the expected value of their implicit promotion-based component has decreased. To compensate themselves for the overall decrease in her compensation contract, non-promoted directors may more aggressively trade on her private information because they are privy to price-sensitive information that outsiders do not know. This study investigates the causal relationship between losing the CEO promotion opportunity and the director trading profitability.

I eliminate the endogeneity by using a matched sample to specify a diff-in-diff regression. I show that losing the CEO competition causes an increase (decrease) in the abnormal return yielded by the non-promoted directors' purchase (sell) transactions. The results indicate that directors indeed trade on their private information more aggressively and incorporate more positive (negative) private information into their purchase (sell) transactions. The more negative abnormal return generated by their sell transactions persist until one year after losing the tournament. In contrast, the increase in the abnormal returns from by their purchase transactions is only observed in the year of losing CEO promotion competition.

Moreover, insiders with higher implicit promotion-based component incorporate more negative private information into their sell transactions, supporting the argument that insiders trade to compensate themselves for the forgone promotion opportunity. These changes in trading profitability are in addition to the profitability changes attributed to the different level of firm-level price information informativeness. My results remain the same if I use the last fiscal year former CEO's age as my IV and estimate a 2SLS regression to eliminate the endogeneity. Directors are more sophisticated when

selling their shares than buying shares due to the asymmetric litigation risk embedded in these two types of transactions. They will incorporate more negative information into their sell transactions and execute more opportunistic sells when the newly appointed CEO increases their holdings. The same trading strategy is not witnessed when directors buy shares. Lastly, I revisit the findings in Kale *et al.* (2009) and show that the insider trading opportunity will weaken the positive relationship between the tournament incentives and firm performance because insiders will use their transactions to realise the tournament incentives prior to the tournament.

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Table 1: CEO Turnover Summary

Table 1 presents a summary of CEO turnover event, insider transactions in different fiscal years. I identify CEO turnover events by using Execucomp historical annual CEO flag (*ceoann*). In column (2), I report the number of external promotions. I define an external CEO promotion if the incoming CEO has not worked for the firm within the event window of (-5, -2). In column (4), I report the number of CEO Turnover after removing confounding events. In column (5) to (8), I exclude all CEO transactions and transactions occurred in the confounding events. In column (7) and (8), I report the yearly average insider transaction value. I aggregate insider purchase and sell transactions at the daily frequency by using the closing price at the transaction day times the number of shares bought/sold to compute the individual transaction value.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fiscal Year	No. CEO Turnover	No. external CEO Promo.	No. of Non-CEO Director	Isolated CEO Turnover with Insider Trading	Matched non-CEO Insider Purchase Sample	Matched non-CEO Insider Sell Sample	Average non-CEO Insider Purchase Value ($000)	Average non-CEO Insider Sell Value ($000)
1996			10,045		711	4,011	138.23	1,408.52
1997	171	40	10,389	65	840	5,468	156.54	910.07
1998	199	60	10,925	95	1,170	5,277	113.10	964.49
1999	194	79	10,403	87	1,188	5,061	109.77	1,322.45
2000	239	85	9,750	104	988	6,297	181.07	1,517.59
2001	251	79	9,713	112	559	6,786	94.05	867.65
2002	181	65	9,884	73	708	5,700	75.42	686.37
2003	202	66	10,075	87	503	7,922	93.61	910.97
2004	198	75	9,152	82	327	8,923	150.71	960.54
2005	220	84	7,635	97	294	7,603	345.33	1,043.40
2006	195	59	9,103	88	329	9,267	278.93	987.41
2007	237	79	10,854	119	646	9,960	221.14	923.73
2008	262	73	10,416	122	1,001	6,287	161.35	825.85
2009	222	53	9,870	93	588	5,811	63.87	608.25
2010	179	39	9,581	77	298	7,125	123.84	736.35
2011	211	41	9,447	89	566	8,035	238.71	792.32
2012	222	52	9,312	110	485	8,672	81.88	876.73
2013	211	32	9,191	107	248	9,644	531.51	966.48
2014	200	27	9,036	107	296	7,208	171.67	1,068.98
2015	213	14	8,795	104	399	5,129	301.97	1,087.62
2016	219	27	8,344	110	282	3,889	176.48	1,005.09
2017	218	22	7,966	96	214	4,125	254.86	1,057.52
2018	197	14	7,579	53	72	1,328	175.32	1,232.57
2019	197	13	6,751	92	310	2,745	259.11	1,204.34
All	4,838	1,178	224,216	2,169	13,022	152,273	162.88	969.29

Table 2: Summary Statistics

Table 2 reports the summary statistics for the main sample with matched firm. In Panel A (B), I report the sample averages for the non-CEO insider purchase (sell) trades around CEO turnover event. $OutsiderD_{i,j}$ is a dummy equal to one if the promoted CEO is an outsider; $COOD_{i,j}$ is a dummy equal to one if the CEO succession was planned in $(-2,-1)$; *pay_gap_firm* is the natural logarithm of the difference between the adjusted CEO total compensation (*tdc1*) and the median adjusted total compensation of non-CEO insiders. Both *pay_gap_firm* and *total_compensation* are deflated to 2010 CPI. $ret30_{j,(d-1,d-30)}$ and $mom_{j,(d-31,d-364)}$ are the long-term and short-term stock price momentum; $bm_{j,m-1}$, $roa_{j,t-1}$, $rd_{j,t-1}$ and $size_{j,m-1}$ proxy for growth, profitability, research and development cost, and size of the firm, respectively; $illiq_{j,m-1}$ is the Amihud (2002) illiquidity measure; $numest_{j,m-1}$ is the financial analyst coverage; $delta_{i,t-1}$ is a dollar change in director *i*'s wealth associated with a 1% change in the firm's stock price (in $000); $vega_{i,t-1}$ is the dollar change in director *i*'s wealth associated with a 0.01 change in the standard deviation of the firm's returns (in $000); $OutsiderD_{i,j}$ is a dummy variable equals to of one for insider transactions for firms with outside CEO appointment during the year $(0,1)$, and zero otherwise; $COOD_{i,j}$ is a dummy variable equals to of one for non-promoted insider transactions for COO firms during the year $(0,1)$, and zero otherwise; $high\_incentiveD_{i,t-1}$ is a dummy variable equals to one for high (in the top three) incentive directors and zero otherwise; $rating_{i,t-1}$ is the yearly industry average S&P long-term rating from Compustat, where I assign AAA a value 2 to CC a value of 23, and then scaled by dividing by 9, so one unit in the increase in the scaled rating corresponding to an increase in rating from AAA to BBB and an increase in rating from BBB to CCC; $CEO\_IT\_Net\_Value_{i,t}$ is the net insider trading value of the current CEO. Appendix 3 details the variables. ***, **, * indicate the sample mean is statistically different at the 99%, 95% and 90% confidence level, respectively. In the column Mean (Median), ^{a}, ^{b}, ^{c} indicate significance at the 99%, 95% and 90% confidence level in the t-statistics in differences in means assuming unequal variance (Wilcoxon rank-sum test for equal median) between (-2, -1) and (0, 1). All variables except insider purchase size and shares are winsorised at the top 99% and the bottom 1% level.

	Panel A: Non-CEO Insider Purchases around CEO Turnover Event for Insider Purchase					
	Event Window (-2, -1)			Event Window (0, 1)		
Variable	Mean	Median	Observation	Mean	Median	Observation
BHAR_m_365	0.059**	-0.059	834	0.304*** a	0.119 a	818
pay_gap_firm (000s)	1,560.411***	696.403	742	2,079.033*** a	674.560	832
Non-CEO compensation (000s)	1,403.734***	893.773	834	1,070.692*** a	681.124 a	832
illiq (000s)	0.271***	0.042	831	0.576*** a	0.087 a	832
marketcap (million)	2,425.926***	834.245	834	1,765.036*** c	545.452 a	832
Mom	0.059***	0.050	801	0.000 b	0.042	831
ret30	-0.067***	-0.056	717	-0.021*** a	-0.029 a	709
bm	0.787***	0.597	833	0.883*** b	0.752 a	832
numest	7.753***	6.000	834	5.905*** a	5.000 a	832
ROA	0.029***	0.025	834	-0.009** a	0.005 a	832
rd	0.028***	0.000	834	0.034***	0.001 a	832
delta	174.156***	15.596	805	25.120*** a	11.540 a	767
vega	18.917***	5.929	803	11.119*** a	5.528	760
$OutsiderD_{i,j}$	0.000	0.000	834	0.369*** a	0.000 a	832
$COOD_{i,j}$	0.000	0.000	834	0.133*** a	0.000 a	832
$high\_incentiveD_{i,t-1}$	0.388***	0.000	834	0.453*** a	0.000 a	832

$rating_{i,t-1}$	1.325***	1.353	825	1.319***	1.366	821
$CEO\_IT\_Net\_Value_{i,t}$	-819,345***	0	834	300,034*** [a]	-42,188 [a]	832
Average Purchase No. Shares	12,255***	2,882	834	10,176***	2,000 [a]	832
Average Purchase Value	156,920***	38,743	834	163,246***	19,689 [a]	832
Average No of Observations	417			416		

Panel B: Non-CEO Insider Sell Trades around CEO Turnover Event

	Event Window (-2, -1)			Event Window (0, 1)		
Variable	Mean	Median	Observation	Mean	Median	Observation
BHAR_m_365	0.057***	0.012	17,137	0.026*** [a]	-0.005 [a]	12,676
pay_gap_firm (000s)	3,507.651***	2,183.192	16,194	3,340.159*** [a]	2,147.950 [a]	13,019
Non-CEO compensation (000s)	2,308.358***	1,400.411	17,153	2,143.866*** [a]	1,346.983 [a]	13,062
illiq (000s)	0.049***	0.007	17,146	0.032*** [a]	0.005 [a]	13,062
market cap (million)	12,092.906***	2,751.448	17,153	14,112.585*** [a]	3,361.305 [a]	13,062
mom	0.320***	0.264	16,798	0.288*** [a]	0.240 [a]	13,059
ret30	0.059***	0.053	14,452	0.056*** [a]	0.048 [a]	11,048
bm	0.419***	0.334	17,143	0.418***	0.337 [a]	13,062
numest	12.497***	11.000	17,153	12.492***	11.000	13,062
ROA	0.064***	0.062	17,150	0.061*** [a]	0.060	13,062
rd	0.058***	0.000	17,153	0.078*** [a]	0.005 [a]	13,062
delta	229.445***	65.856	16,295	154.390*** [a]	57.420 [a]	12,345
vega	49.088***	18.484	16,293	48.193***	16.870 [a]	12,342
$OutsiderD_{i,j}$	0.000	0.000	17,153	0.295*** [a]	0.000 [a]	13,062
$COOD_{i,j}$	0.000	0.000	17,153	0.186*** [a]	0.000 [a]	13,062
$high\_incentiveD_{i,t-1}$	0.537***	1.000	17,153	0.562*** [a]	1.000 [a]	13,062
$rating_{i,t-1}$	1.380***	1.431	17,069	1.392*** [a]	1.439 [a]	12,645
$CEO\_IT\_Net\_Value_{i,t}$	-15,508,847***	-3,497,724	17,153	-2,581,300*** [a]	0,000.000 [a]	13,062
Average Sell No. Shares	33,382.895***	11,191	17,153	27,781*** [a]	10,000 [a]	13,062
Average Sell Value	1,039,358.5***	355,280	17,153	944,193*** [a]	327,369 [a]	13,062
Average Yearly No of Observations	8,576			6,531		

Table 3: Insider trading propensity after losing the CEO competition.

Table 3 Panel A reports the summary statistics for the nearest neighbour matching. Appendix 3 defines all variables in the table. Firms that have CEO turnover event in year *t* are matched with firms on the average insider purchase/sell profitability, logarithm of the total asset and the book-to-market ratio in the fiscal year *t-1*. The distance is calculated by using Mahalanobis distance. Each treated firm is matched with one control firm. I restrict that the control firm sample does not have any CEO turnover in (-2, 2). In Panel A, I report the summary statistics at firm level for both the treated firms and control firms in the pre-CEO turnover period (-2, -1). Column (3) and (6) reports the t-test results by assuming unequal variance between treated and control firms for insider purchase and sell transaction, respectively. Panel C reports the linear probability regression output. The dependent variable is $opp\_D_{I,t}$ equal to one for insider transactions executed by opportunistic traders, and zero otherwise. I identify opportunistic traders by following Cohen *et al.* (2012). Appendix 3 defines all control variables in the table. ***, **, and * denote significance at the 99%, 95% and 90% confidence level, respectively. Standard errors reported in parentheses are computed based on robust standard errors clustered at the firm-month level. All variables are winsorised at the top 99% and the bottom 1% level.

Panel A: Summary Statistics in Pre-Treatment Period (-2, -1)-Level						
	Insider Purchase			Insider Sell		
	(1)	(2)	(3)	(4)	(5)	(6)
	Treated Firms	Control Firms	Difference (1)-(2)	Treated Firms	Control Firms	Difference (4)-(5)
$\Delta BHAR\_m\_365_{(-2,-1)}$	0.124	0.111	0.013	-0.055	-0.058	0.003
	(0.030)	(0.033)	(0.045)	(0.005)	(0.005)	(0.008)
$total\ asset_{i,t-1}$	7.322	7.238	0.083	7.99	7.92	0.04
	(0.085)	(0.081)	(0.118)	(0.033)	(0.033)	(0.047)
$mom_{j,\ t,(d-31,d\ -364)}$	0.148	0.184	-0.036	0.176	0.192	-0.015
	(0.025)	(0.020)	(0.033)	(0.007)	(0.007)	(0.010)
$bm_{j,m-1}$	0.634	0.634	0.000	0.492	0.488	0.003
	(0.019)	(0.022)	(0.029)	(0.007)	(0.007)	(0.010)
$roa_{j,t-1}$	0.027	0.033	-0.006	0.053	0.055	-0.002
	(0.001)	(0.000)	(0.007)	(0.002)	(0.002)	(0.003)
Non-CEO total comp ($000s)	1,231	1,325	-94.04	2,115	1,971	144***
	(59.62)	(92.52)	(110.06)	(20.24)	(17.69)	(26.89)
Transaction Value	156,920	89,887	67,032***	1,004,076	1,039,358	35,285
	(16,169)	(19,477)	(25,314)	(18,873)	(20,050)	(27,535)
N Matched Firm-Year	192	192		1331	1331	
N Transactions.	834	889		17,153	17,804	
Panel B: Summary Statistics of BHAR in event window (-2, +1)						
$BHAR\_m\_365_{(t = -2)}$	-0.017	-0.002	-0.015	0.069***	0.070***	-0.001
	(0.029)	(0.022)	(0.037)	(0.004)	(0.004)	(0.006)
$BHAR\_m\_365_{(t = -1)}$	0.085	0.115	-0.030	0.047***	0.040***	0.007
	(0.029)	(0.021)	(0.036)	(0.004)	(0.004)	(0.006)
$BHAR\_m\_365_{(t = 0)}$	0.405	0.213	0.192***	0.032***	0.043***	-0.011*
	(0.032)	(0.026)	(0.041)	(0.004)	(0.006)	(0.007)

$BHAR\_m\_365_{(t = +1)}$	0.075	0.279	-0.204***	0.014***	0.038***	-0.024***
	(0.038)	(0.050)	(0.062)	(0.004)	(0.004)	(0.006)
Panel C: Insider trading propensity after losing the CEO competition						
	Insider Purchase Transactions			Insider Sell Transactions		
Year *t*	(0,0)	(1,1)		(0,0)	(1,1)	
$Post_{i,t}$	-0.050**	-0.073		-0.025***	-0.066***	
	(0.023)	(0.054)		(0.008)	(0.011)	
$Treat_{i,t}$	-0.064**	-0.107**		-0.006	-0.015	
	(0.027)	(0.044)		(0.010)	(0.010)	
$(Treat \times Post)_{i,t}$	0.043	-0.024		0.025**	0.047***	
	(0.029)	(0.084)		(0.012)	(0.016)	
$CEO\_IT_{i,t}$	-0.025*	0.031**		0.008***	0.006**	
	(0.013)	(0.015)		(0.003)	(0.003)	
Constant	0.674	1.668*		1.295***	1.391***	
	(0.614)	(0.942)		(0.100)	(0.111)	
Control Variables	Yes	Yes		Yes	Yes	
Sample	987	715		30,879	28,462	
Within R^2	0.17	0.22		0.36	0.37	
Fixed Effect	Firm, Month	Firm, Month		Firm, Month	Firm, Month	

Table 4: Difference-in-difference regression output

The dependent variable is BHAR_m_365. $(Post \times Treat)_{I,t}$ is a dummy variable equals to one for firms that have a CEO turnover in year *t*, and zero otherwise. Other variables are described in Table 2. I only include sample in pre-CEO turnover period (-2, -1) and post-CEO turnover period (t,t+i). I do not include years in the post-CEO turnover period other than *t*. Standard errors reported in parentheses are computed based on robust standard errors clustered at the firm-month level. ***, **, and * denote significance at the 99%, 95% and 90% confidence level, respectively. All variables are winsorised at the top 99% and the bottom 1% level.

	Insider Purchase			**Insider Sell**		
Year *t*	(0,1)	(0,0)	(1,1)	(0,1)	(0,0)	(1,1)
	(1)	(2)	(3)	(4)	(5)	(6)
$Post_{i,t}$	0.105	-0.002	0.152	0.021***	0.007	0.042***
	(0.073)	(0.051)	(0.181)	(0.008)	(0.009)	(0.011)
$Treat_{i,t}$	-0.320***	-0.349***	-0.342**	0.017*	0.011	0.008
	(0.108)	(0.117)	(0.133)	(0.010)	(0.010)	(0.010)
$(Treat \times Post)_{i,t}$	0.082	0.245**	-0.177	-0.038***	-0.030**	-0.048***
	(0.110)	(0.101)	(0.256)	(0.013)	(0.015)	(0.017)
$CEO\_IT_{i,t}$	0.036	0.015	0.108**	0.010***	0.009***	0.013***
	(0.029)	(0.024)	(0.044)	(0.003)	(0.003)	(0.003)
$COOD_{i,j}$	-0.442***	-0.421***	-0.440*	0.060***	0.069***	0.054**
	(0.135)	(0.145)	(0.227)	(0.018)	(0.021)	(0.025)
$ret30_{j,t,(d-1,d-30)}$	-0.811**	-0.333**	-0.963**	-0.171***	-0.185***	-0.131***
	(0.317)	(0.152)	(0.447)	(0.032)	(0.032)	(0.036)
$mom_{j,\ t,(d-31,d\ -364)}$	-0.182***	-0.102	-0.105	-0.035***	-0.039***	-0.036**
	(0.070)	(0.079)	(0.100)	(0.012)	(0.012)	(0.014)
$size_{j,m-1}$	-0.909***	-0.766***	-0.764***	-0.275***	-0.263***	-0.276***
	(0.159)	(0.116)	(0.243)	(0.012)	(0.011)	(0.014)
$delta_{i,t-1}(\times 0.01)$	0.002***	0.135***	0.129**	0.002**	0.001*	0.002**
	(0.000)	(0.051)	(0.053)	(0.001)	(0.001)	(0.001)
$vega_{i,t-1}(\times 0.01)$	-0.257***	-0.240***	-0.201*	-0.015***	-0.007**	-0.009**
	(0.092)	(0.087)	(0.119)	(0.004)	(0.003)	(0.004)
$lncompen_{j,t-1}$	0.018	0.033	0.027	0.032***	0.026***	0.035***
	(0.035)	(0.029)	(0.035)	(0.007)	(0.006)	(0.007)
$rating_{i,t-1}$	3.996***	3.207***	3.963***	-0.100	0.011	-0.147*
	(0.950)	(0.596)	(1.375)	(0.076)	(0.078)	(0.084)
Constant	0.777	0.895	-0.802	2.120***	1.934***	2.153***
	(0.907)	(0.938)	(1.026)	(0.146)	(0.145)	(0.166)
Sample	2,126	1,833	1,328	45,776	36,829	33,658
Within R^2	0.38	0.37	0.39	0.15	0.15	0.14
Fixed Effect	Firm, Month	Firm, Month	Firm, Month	Firm, Month	Firm, Month	Firm, Month

Table 5: Insider heterogeneity and their trading intensity

Table 5 reports the fixed effect regression output based on the matched sample. Firms that have CEO turnover event in year *t* are matched with firms on the average insider purchase/sell profitability, logarithm of the total asset and the book-to-market ratio in the fiscal year *t-1*. The distance is calculated by using Mahalanobis distance. I restrict that the control firm sample does not have any CEO turnover in (-2, 2). In Panel A, I interact the treatment dummy and post-event dummy with $\text{Pay\_rank}_{i,t}$ which is the rank of non-promoted director sorted by their total compensation in year -1 among all tournament competitors. In Panel B, the moderator variable is $ln\text{age}_{I,t}$ which is the natural logathrim of the age of the insider *i* in year *t*. I include the same set of control variables as in Equation (2). In Panel C, the moderator variable is $SHD_{I,t}$, which is a dummy variable equals to one for short-horizon insiders identified by following Akbas, *et al.* (2020), and zero otherwise. I include firm and month levels and control variables described in Table 2 and detailed in Appendix 3. Standard errors in parentheses are based on robust standard errors clustered at the firm-month level. ***, **, and * denote significance at the 99%, 95% and 90% confidence level, respectively. All variables are winsorised at the top 99% and the bottom 1% level.

	Panel A: Tournament Prize			
	Insider Purchase		**Insider Sell**	
	(1)	(2)	(3)	(4)
Year *t*	(0,0)	(1,1)	(0,0)	(1,1)
Dependent Variable	BHAR_m_365	BHAR_m_365	BHAR_m_365	BHAR_m_365
$\text{Post}_{i,t}$	0.034	-0.090	0.023	0.084***
	(0.097)	(0.225)	(0.015)	(0.018)
$\text{Treat}_{i,t}$	-0.353**	-0.309*	0.022	0.041***
	(0.136)	(0.177)	(0.015)	(0.016)
$(\text{Treat}\times\text{Post})_{i,t}$	0.248*	-0.072	-0.076***	-0.091***
	(0.150)	(0.363)	(0.022)	(0.027)
$\text{Pay\_rank}_{i,t}$	0.003	-0.003	-0.007**	0.006**
	(0.020)	(0.032)	(0.004)	(0.003)
$(\text{Post}\times\text{Treat}\times\text{Pay\_rank})_{i,t}$	-0.007	-0.083	0.018***	0.019***
	(0.031)	(0.078)	(0.006)	(0.007)
Control variables and main levels	Yes	Yes	Yes	Yes
Sample	1,590	1,100	34,883	28,988
	Panel B: Age Effect			
	Insider Purchase		**Insider Sell**	
Year *t*	(0,0)	(1,1)	(0,0)	(1,1)
Dependent Variable	BHAR_m_365	BHAR_m_365	BHAR_m_365	BHAR_m_365

$Post_{i,t}$	2.929***	3.604**	0.542***	0.651***
	(1.005)	(1.717)	(0.209)	(0.226)
$Treat_{i,t}$	0.697	-0.230	0.618***	0.720***
	(1.026)	(0.967)	(0.207)	(0.215)
$(Treat \times Post)_{i,t}$	-1.988	0.634	-0.743**	-1.032***
	(1.412)	(2.459)	(0.322)	(0.384)
$lnage_{i,t}$	0.312*	0.185	0.137***	0.152***
	(0.180)	(0.162)	(0.037)	(0.037)
$(Post \times Treat \times lnage)_{i,t}$	0.556	-0.133	0.183**	0.250***
	(0.356)	(0.631)	(0.081)	(0.096)
Control variable and main levels	Yes	Yes	Yes	Yes
Sample	1,415	1,074	32,158	29,552
	Panel C: Investment Horizon			
	Insider Purchase		**Insider Sell**	
Year *t*	(0,0)	(1,1)	(0,0)	(1,1)
Dependent Variable	BHAR_m_365	BHAR_m_365	BHAR_m_365	BHAR_m_365
$Post_{i,t}$	0.007	-0.053	0.009	0.043***
	(0.050)	(0.065)	(0.009)	(0.011)
$Treat_{i,t}$	-0.328***	-0.234**	0.015	0.010
	(0.102)	(0.103)	(0.011)	(0.010)
$(Treat \times Post)_{i,t}$	0.167***	0.177*	-0.034**	-0.053***
	(0.074)	(0.104)	(0.016)	(0.017)
$SHD_{i,t}$	0.061	0.227	0.032	0.038*
	(0.174)	(0.220)	(0.021)	(0.020)
$(Post \times Treat \times SHD)_{i,t}$	-0.177	0.090	0.070**	0.080*
	(0.252)	(0.541)	(0.035)	(0.044)
Control variable and main levels	Yes	Yes	Yes	Yes
Sample	1,833	1,328	36,829	33,658

Table 6: Insider trading after CEO turnover and changes in firm performance, investor sentiment and change of cost of capital

Table 6 reports the fixed effect regression output based on matched sample in Table 4. In Panel A, the dependent variable is the change in return on asset between year t and year t+2. In Panel B, the dependent variable is the change in investor sentiment measured as firm-specific component from the market-to-book decomposition of Rhodes–Kropf, *et al.*, (2005). The change in investor sentiment $\Delta Sentiment_{-1,1}$ is measured between year t-1 to year t+1. In Panel C, I obtain the $\Delta r_{t,t+2}$ by following Cziraki *et al.* (2021) to estimate a modified Fama and French (1993) Three-Factor model. I include the same set of control variables as in Equation (2). The coefficients of these control variables are omitted for brevity. Standard errors reported in parentheses are computed based on robust standard errors clustered at the firm-month level. ***, **, and * denote significance at the 99%, 95% and 90% confidence level, respectively. All variables are winsorised at the top 99% and the bottom 1% level.

	Panel A: Future Firm Performance			
	Insider Purchase		Insider Sell	
	(1)	(2)	(3)	(4)
Year *t*	(0,0)	(1,1)	(0,0)	(1,1)
Dependent Variable	$\Delta ROA_{t,t+2}$	$\Delta ROA_{t,t+2}$	$\Delta ROA_{t,t+2}$	$\Delta ROA_{t,t+2}$
$\text{Post}_{i,t}$	-0.001	0.015	-0.001	-0.003
	(0.012)	(0.012)	(0.003)	(0.003)
$\text{Treat}_{i,t}$	-0.087***	-0.069***	0.015***	0.019***
	(0.022)	(0.019)	(0.004)	(0.004)
$(\text{Post}\times\text{Treat})_{i,t}$	0.007	-0.018	-0.020***	-0.011**
	(0.015)	(0.025)	(0.005)	(0.005)
Other Control Variable	Yes		Yes	Yes
Within R-square	0.15	0.19	0.07	0.06
Fixed Effect	Firm, Month	Firm, Month	Firm, Month	Firm, Month
Sample	1,727	1,271	35,582	32,628
	Panel B: Investor Sentiment			
	Insider Purchase		Insider Sell	
Year *t*	(0,0)	(1,1)	(0,0)	(1,1)
Dependent Variable	$\Delta Sentiment_{t-1,t+1}$	$\Delta Sentiment_{t-1,t+1}$	$\Delta Sentiment_{t-1,t+1}$	$\Delta Sentiment_{t-1,t+1}$
$\text{Post}_{i,t}$	-0.086	-0.284**	-0.003	0.037**
	(0.064)	(0.113)	(0.014)	(0.017)
$\text{Treat}_{i,t}$	0.038	0.104	0.034**	0.034**
	(0.134)	(0.137)	(0.016)	(0.017)
$(\text{Post}\times\text{Treat})_{i,t}$	0.046	0.038*	-0.054**	-0.062**
	(0.121)	(0.219)	(0.023)	(0.026)
Other Control Variable	Yes		Yes	Yes
Within R-square	0.07	0.18	0.07	0.10
Fixed Effect	Firm, Month	Firm, Month	Firm, Month	Firm, Month

Sample	1,728	1,288	35,894	31,232
	Panel C: Change in Cost of Capital			
	Insider Purchase		Insider Sell	
Year *t*	(0,0)	(1,1)	(0,0)	(1,1)
Dependent Variable	$\Delta r_{t,t+2}$	$\Delta r_{t,t+2}$	$\Delta r_{t,t+2}$	$\Delta r_{t,t+2}$
$\text{Post}_{i,t}$	-0.000	0.007**	-0.000	-0.000
	(0.013)	(0.003)	(0.000)	(0.000)
$\text{Treat}_{i,t}$	-0.085***	0.008***	-0.001	-0.001
	(0.022)	(0.002)	(0.000)	(0.000)
$(\text{Post}\times\text{Treat})_{i,t}$	0.005	-0.004***	0.001**	0.001*
	(0.016)	(0.003)	(0.000)	(0.001)
Other Control Variable	Yes	Yes	Yes	Yes
Within R-square	0.14	0.21	0.05	0.05
Fixed Effect	Firm, Month	Firm, Month	Firm, Month	Firm, Month
Sample	1,727	1,334	37,001	33,727

Table 7: Insider trading and tournament incentives

Table 7 covers all firm-year observations in Execucomp during 1996-2019. The control variables are $rd_{j,t}$,$sale_{j,t}$,capital-to-sale$_{j,t}$, advertising-to-sale$_{j,t}$, dividend-yield$_{j,t}$,$lnage_{j,t}$ and skt_ret_volatility$_{i,t}$ in all six columns. The regression specification is a shorter version of Kale *et al.* (2009). Appendix 3 defines all variables in the table. In column (1) and (2), I regress Tobin's Q and ROA on all control variables with firm and year fixed effects, respectively. In column (3) to (6), I conduct a 2SLS regression with two first-stage regressions. My endogenous variables are $pay\_gap_{j,t}$ and the interaction term between $pay\_gap_{j,t}$ and my insider trading intensity measure which is $all\_IT_{i,t}$. In the first stage regression, I employ the median $pay\_gap_{j,t}$ in the same sales quintiles and the interaction term between the $all\_IT_{i,t}$ and $pay\_gap_{j,t}$ as my two IVs in column (3) and (4). In column (5) and (6), I use the sum of the maximum federal and state long-term capital gain tax rates as the IV for $all\_IT_{i,t}$, and use the product between the tax rate and median $pay\_gap_{j,t}$ as the IV for the endogenous interaction term. In the second stage, I regress the Tobin's Q and ROA on all control variables with predicted $\widehat{pay\_gap}_{j,t}$, $\widehat{all\_IT}_{j,t}$ and predicted interaction term. I cluster my standard error at firm level and report it in the parentheses. ***, **, and * denote significance at the 99%, 95% and 90% confidence level, respectively. All variables are winsorised at the top 99% and the bottom 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Fixed Effect		2SLS-Second Stage			
			One IV		Two IVs	
Dependent Variable	Tobin's $Q_{j,t}$	$ROA_{j,t}$	Tobin's $Q_{j,t}$	$ROA_{j,y}$	Tobin's $Q_{j,t}$	$ROA_{j,y}$
$pay\_gap_{j,t}$	0.014^{***}	0.001^{***}				
	(0.005)	(0.000)				
$\widehat{pay\_gap}_{j,t}$			0.084^{***}	0.002^{*}	0.168^{**}	0.015^{**}
			(0.016)	(0.001)	(0.086)	(0.007)
$\widehat{pay\_gap \times all\_IT}_{j,t}$			-0.008^{***}	-0.003^{***}	-0.037^{*}	-0.005^{**}
			(0.002)	(0.000)	(0.022)	(0.002)
$all\_IT_{j,t}$	0.021^{***}	0.002^{***}	0.088^{***}	0.004^{***}		
	(0.002)	(0.001)	(0.014)	(0.001)		
$\widehat{all\_IT}_{i,t}$					0.383^{**}	0.029^{*}
					(0.179)	(0.015)
Other Control Variable	Yes	Yes	Yes	Yes	Yes	Yes
First-Stage F-$\widehat{NPED}_{I,t}$			334.37^{***}	345.28^{***}	209.57^{***}	209.60^{***}
Sanderson-Windmeijer F-$\widehat{NPED}_{I,t}$					11.04^{***}	11.14^{***}
Sanderson-Windmeijer F-Interaction					10.37^{***}	10.46^{***}
Sanderson-Windmeijer F - $\widehat{all\_IT}_{I,t}$					9.06^{***}	9.11^{***}
Sample	35,806	35,822	35,806	35,822	34,258	34,274
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes

Table 8: 2SLS regression result for purchase and sell transactions

Panel A reports the output of the 2SLS regression. The dependent variable in the first stage of the regression is $NPED_{,I,t}$. It is dummy variable that equals to one for the purchase/sell transactions of promotion rejectees in $(0,0)$ and $(1,1)$ with year 0 as the CEO turnover year. $NPED_{,I,t}$ is equal to zero for years outside the event window and $(-2,-1)$. I exclude transactions in year +2 to remove confounding events. Column (1) to (2) focus on insider purchase transactions and column (3) to (5) focus on insider sell transactions. For years in the post turnover period other than year *t*, it is not included in the regression. I report the year *t* at the top of the table. I remove all confounding events, CEO observations and insider transactions conducted by non-competitors. Appendix 3 defines all variables in the table. The instrumental variable is the last fiscal year's previous CEO age. The sample contains the companies and directors in the Execucomp database throughout 1996 to 2019. I calculate *ret30, mom, bm, numest, illiq* and *size* at the end of last month relates to the insider transaction date that will be used in the second stage of IV regression. Panel B extends the holding period for sequential sells from 1 day after the first transaction to 365 days after the last transaction. I compute the daily average BHAR_m_365×252, the median number of trading days in a 365-calendar day holding period. the regression specification is the same with Panel A. Standard errors reported in parentheses are computed based on robust standard errors clustered at the Firm-Month level. ***, **, and * denote significance at the 99%, 95% and 90% confidence level, respectively. All variables are winsorised at the top 99% and the bottom 1% level.

	Insider Purchase Transactions		**Insider Sell Transactions**	
	(1)	(2)	(3)	(4)
			Panel A: 2SLS Regression Results	
			First Stage	
Year *t*	(0,0)	(1,1)	(0,0)	(1,1)
Dependent Variable	$NPED_{i,t}$	$NPED_{i,t}$	$NPED_{i,t}$	$NPED_{i,t}$
Instrumental Variable	$age\_ceo_{i,t-1}$	$age\_ceo_{i,t-1}$	$age\_ceo_{i,t-1}$	$age\_ceo_{i,t-1}$
	0.018***	-0.019***	0.010***	-0.019***
	(0.003)	(0.004)	(0.001)	(0.001)
Control Variable	Yes	Yes	Yes	Yes
			Second Stage	
Dependent Variable	BHAR_m_365	BHAR_m_365	BHAR_m_365	BHAR_m_365
Endogenous Variable				
$\widehat{NPED}_{i,t}$	0.626*	-0.790	-2.911**	-0.793***
	(0.369)	(0.538)	(1.332)	(0.259)
$\widehat{NPED \times CEO\_IT}_{i,t}$			1.794***	0.193**
			(0.695)	(0.079)
Control Variable				
$CEO\_IT_{i,t}$	0.069***	0.080***	-0.038	-0.012
	(0.022)	(0.028)	(0.023)	(0.008)
$OutsiderD_{i,j}$	-0.244**	0.032	0.944*	0.367***
	(0.102)	(0.193)	(0.570)	(0.104)
$COOD_{i,j}$	0.017	-0.109	-0.008	0.110***
	(0.032)	(0.083)	(0.012)	(0.042)
$high\_incentiveD_{i,t-1}$	-0.011	0.024	-0.010	0.025***

	(0.028)	(0.053)	(0.012)	(0.004)
$pay\_gap_{j,t-1}$	-0.001	-0.011	0.022**	0.003
	(0.022)	(0.030)	(0.010)	(0.003)
$ret30_{j,t,(d-1,d-30)}$	-0.470***	-1.110***	-0.171***	-0.151***
	(0.119)	(0.366)	(0.050)	(0.033)
$mom_{j,\ t,(d-31,d\ -364)}$	-0.156***	-0.485***	-0.006	-0.011
	(0.055)	(0.160)	(0.023)	(0.014)
$bm_{j,m-1}$	0.130	-0.146	0.060	0.047**
	(0.089)	(0.219)	(0.042)	(0.023)
$numest_{j,m-1}$	-0.010	-0.015	-0.001	0.002**
	(0.007)	(0.011)	(0.002)	(0.001)
$illiq_{j,m-1}$	0.044	0.112	-0.132**	-0.026
	(0.028)	(0.089)	(0.067)	(0.052)
$size_{j,m-1}$	-0.358***	-0.800***	-0.285***	-0.247***
	(0.060)	(0.186)	(0.025)	(0.012)
$roa_{j,t-1}$	-0.017	-0.678	-0.172	-0.041
	(0.367)	(0.627)	(0.223)	(0.078)
$delta_{i,t-1}(\times 0.01)$	0.015	0.019	0.000	0.000
	(0.011)	(0.013)	(0.001)	(0.001)
$vega_{i,t-1}(\times 0.01)$	-0.094**	-0.018	0.003	-0.011**
	(0.047)	(0.070)	(0.007)	(0.005)
$rd_{j,t-1}$	-1.459*	-2.839**	-0.323	0.090
	(0.777)	(1.352)	(0.380)	(0.185)
$lncompen_{j,t-1}$	0.070**	0.149**	0.034**	0.053***
	(0.035)	(0.062)	(0.015)	(0.008)
$rating_{i,t-1}$	0.531	0.995	-0.061	0.021
	(0.362)	(1.006)	(0.126)	(0.063)
Sample	2,416	2,630	37,554	40,606
Fixed Effect	Firm, Month	Firm, Month	Firm, Month	Firm, Month
Difference in Sargan C (χ^2)	3.31*	2.067	58.08***	26.94***
First-Stage F-$\widehat{NPED}_{I,t}$	27.42***	25.20***	101.78***	508.45***
Anderson-Rubin Wald Test, F statistic	3.68*	2.27	29.93***	11.51***
	Panel B: Dissimulation Strategy Results: t+1 after the first and t+365 after the last transaction			
$\widehat{NPED}_{i,t}$	0.623*	-0.428*	-2.945**	-0.979**
	(0.367)	(0.236)	(1.331)	(0.427)
Control Variables	Yes	Yes	Yes	Yes

Table 9: Robustness Test

Table 9 reports three regression outputs for robustness tests. Appendix 3 defines all variables in the table. Panel A reports the output of the 2nd stage of 2SLS regression by including an extensive set of control variables to partial out the potential channels that CEO age can affect future firm valuation. In Panel B, I employ alternative measure for my dependent variable for different holding horizons. In addition to the BHAR_m_30 and BHAR_m_180, I also report the 4-factor $\alpha_{t+1,t+30}$ calculated by running regression $r_{i,t} - rf_t = \alpha_{i,t} - \beta_1(r_{crsp,t} - rf_t) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 UMD_t + \varepsilon_t$ from the day after insider transaction day to 3/6/12 month. rf_t is the risk-free rate, $r_{crsp,t}$ is CRSP value-weighted market index, SMB_t is small-minus-big factor (size), HML_t is high-minus-low factor (value), and UMD_t is up-minus-down factor (momentum). I time the daily $\alpha_{t+1,t+30}$ by the median number of trading days of 22, 126, 252 in these three holding periods, respectively. I report the coefficient of $\widehat{\text{NPED}}_{I,t}$ by following the specification in Equation (5). I also report the raw cumulative return $ret_{t+1,t+i}$. For insider purchase sample, I do not include the interaction term $\widehat{\text{NPED}}\times\widehat{\text{CEO\_IT}}_{I,t}$ as it is insignificant in all holding periods. I cluster my standard error at the firm-month level and report it in the parentheses. ***, **, and * denote significance at the 99%, 95% and 90% confidence level, respectively. All variables are winsorised at the top 99% and the bottom 1% level. In Panel C, I report the 1,000 placebo test results. I report the average coefficient of $\widehat{\text{NPED}}_{I,t}$, the standard error of the coefficient of $\widehat{\text{NPED}}_{I,t}$ and its skewness. In column (4) to (6), I report the percentage of my placebo test that has both a positive (negative) coefficient of $\widehat{\text{NPED}}_{I,t}$ for purchase (sell) sample and a first-stage F statistics larger than 10. In Column (7), I report the percentage of sample that has a first-stage F statistics larger than 10. In Panel D, I report the 1,000 placebo test results for the diff-in-diff regression. I report the average, median, standard deviation and skewness of the coefficient of the interaction term in column (1), (2), (3), (4), respectively. In column (5) to (7), I report the percentage of my placebo test that has a positive (negative) coefficient of the interaction term for purchase (sell) sample and is statistically significant at the 99%. 95% and 90% confidence level, respectively. Relying on a binomial one-sided test-statistic, none of the proportions are statistically different from the corresponding theoretical level in Panel C and D.

	Panel A: Extended Set of Control Variables			
	(1)	(2)	(3)	(4)
	Insider Purchase		Insider Sell	
Year *t*	(0,0)	(1,1)	(0,0)	(1,1)
	Second Stage			
Dependent Variable	BHAR_m_365	BHAR_m_365	BHAR_m_365	BHAR_m_365
Endogenous Variable				
$\widehat{\text{NPED}}_{i,t}$	1.448**	-7.027	-0.531*	-0.780*
	(0.574)	(7.323)	(0.316)	(0.473)
$\widehat{\text{NPED}}\times\widehat{\text{CEO\_IT}}_{i,t}$			0.324**	0.249**
			(0.146)	(0.119)
Control Variables				
$\text{CEO\_IT}_{i,j}$	0.089*	0.148	-0.004	-0.012
	(0.046)	(0.113)	(0.007)	(0.012)
tobin's $Q_{i,t-1}$	-0.074	0.380	0.012	-0.009
	(0.103)	(0.510)	(0.010)	(0.013)
capital-to-sale$_{j,t-1}$	-0.410**	-0.607**	-0.019	-0.056***
	(0.201)	(0.301)	(0.022)	(0.020)
advertising-to-sale$_{j,t-1}$	20.013	-12.008	-0.372	0.129
	(13.213)	(36.062)	(0.616)	(0.838)
dividend-yield$_{j,t-1}$	0.655	1.667	-0.017	0.056
	(4.777)	(10.590)	(0.348)	(0.085)
$\text{lnage}_{j,t}$	-0.424	0.296	0.014	0.050
	(0.370)	(0.700)	(0.023)	(0.034)
leverage$_{i,t-1}$	-0.694	-0.047	-0.135**	-0.102*
	(0.490)	(1.456)	(0.062)	(0.053)
skt_ret_volatility$_{i,t-1}$	17.409*	16.884	-0.208	-0.848
	(9.555)	(21.345)	(0.643)	(0.694)

capital_intensity$_{i,t-1}$	4.162*	-0.745	-0.003	-0.018
	(2.123)	(4.691)	(0.209)	(0.222)
firm_focus$_{i,t-1}$	0.268	-1.504	-0.075***	-0.015
	(0.262)	(1.795)	(0.028)	(0.035)
cash_flow_vol$_{i,t-1}$	-1.695	-18.148	-0.585	-0.641
	(4.830)	(20.125)	(0.535)	(0.573)
institution_ownership$_{j,q-1}$	0.648	0.007	-0.024	-0.001
	(0.451)	(0.956)	(0.048)	(0.051)
independent_director$_{j,t-1}$	-0.880	-0.765	0.092*	0.164***
	(0.574)	(1.457)	(0.054)	(0.060)
independent_committee$_{j,t-1}$	0.252	0.877	0.200***	0.145***
	(0.234)	(0.723)	(0.038)	(0.042)
analyst_talent$_{j,t-1}$	0.492	2.288	-0.220***	-0.209***
	(0.690)	(2.652)	(0.052)	(0.050)
CEO_tenure$_{j,t-1}$	0.116***	-0.291	0.015***	-0.001
	(0.044)	(0.352)	(0.003)	(0.011)
Other Control Variables	Yes	Yes	Yes	Yes
Sample	1,104	1,169	23,872	25,399
Fixed Effect	Firm, Month	Firm, Month	Firm, Month	Firm, Month
First-Stage F-$\widehat{\text{NPED}}_{I,t}$	34.31***	1.23	266.55***	34.54***
Anderson-Rubin Wald Test, F statistic	6.13***	5.60***	14.43***	3.19**

Panel B: Alternative Return Measure

	Insider Purchase		Insider Sell	
	(1)	(2)	(3)	(4)
Year *t*	(0,0)	(1,1)	(0,0)	(1,1)
BHAR_m_30	-0.054	-0.041	-0.236	-0.060
	(0.065)	(0.059)	(0.175)	(0.057)
BHAR_m_180	0.197	-0.079	-2.026**	-0.379**
	(0.213)	(0.145)	(0.881)	(0.171)
$\alpha_{t+1,t+30}(\times 22)$	0.041	-0.147*	-0.293	-0.035
	(0.074)	(0.077)	(0.207)	(0.068)
$\alpha_{t+1,t+180}(\times 126)$	0.066	0.016	-1.812**	-0.124
	(0.165)	(0.135)	(0.763)	(0.157)
$\alpha_{t+1,t+365}(\times 252)$	0.088	-0.045	-1.765*	-0.466**
	(0.214)	(0.160)	(0.923)	(0.208)
$ret_{t+1,t+30}$	-0.116	-0.059	-0.316	-0.079
	(0.096)	(0.083)	(0.218)	(0.069)
$ret_{t+1,t+180}$	0.269	-0.199	-2.929**	-0.374**
	(0.340)	(0.236)	(1.211)	(0.191)
$ret_{t+1,t+365}$	0.903	-0.845	-3.436**	-0.472*
	(0.815)	(0.557)	(1.740)	(0.278)
BHAR_size_30	-0.016	-0.092	-0.335*	-0.072
	(0.082)	(0.075)	(0.201)	(0.059)
BHAR_size_180	0.427	-0.226	-2.104**	-0.415**
	(0.324)	(0.228)	(0.923)	(0.174)
BHAR_size_365	0.952	-0.840	-2.647*	-0.744***
	(0.781)	(0.557)	(1.373)	(0.257)

Panel C: Placebo Test for 2SLS

(1)	(2)	(3)	(4)	(5)	(6)	(7)
			% Statistically Significant Coefficient with Valid First-Stage F (>10)			IV Significance

	Mean	SD	Skewness	1%	5%	10%	First Stage F>10
$\widehat{NPED}_{i,t}$-Buy Sample	6.007	158.87	28.904	0.00%	0.00%	0.00%	0.40%
$\widehat{NPED}_{i,t}$-Sell Sample	2.174	135.57	11.848	0.20%	0.40%	0.80%	3.4%

Panel D: Placebo Test for Diff-in-Diff regression

					% statistically significant positive (negative) for buy (sell)		
	Mean	Median	SD	Skewness	1%	5%	10%
$(Post \times Treat)_i$-Buy Sample	-0.049	-0.038	0.218	-0.328	0.70	3.2%	5.8%
$(Post \times Treat)_i$-Sell Sample	0.132	0.123	0.126	0.428	0.60	1.00	1.40

Appendix 1:Data Cleaning Process Details

Walker (2009) and Coles, Daniel and Naveen (2014) point out that Execucomp's total compensation figure is not comparable before and after 2006 because of the passage of Financial Accounting Standards Board (FASB) 123R revision to the stock and options accounting and an expanded compensation disclosure requirement regarding the director compensation disclosure. I follow Coles *et al.* (2014), Kini and Williams (2012) and Brockman, Lee and Salas (2016) to correct my pre- and post-2006 total compensation item *tdc1*[36]. Specifically, the stock option was valued using the Black-Scholes formula for the pre-2006 period but reported its fair value for the post-2006 period. A small number of firms still report their proxy statements in the old reporting format in 2006, I use the reporting flag to identify (*old_datafmt_flag*) these firms. Then, I correct the post-2006 period option value using the same set of Black-Scholes assumption that Execucomp used for the pre-2006 period. The Black-Scholes assumption used are listed as follows:

1. Strike price per share: The strike price specified in its proxy statement. (*expric*)
2. Market price per share: The market price per share is assumed to be equal to the strike price per share unless specified in its proxy statement. (*mktprice*)
3. Option grant terms: Options were assumed to be granted on July 1st of the particular year for which data were reported. The option's nominal term was calculated as the period between July 1st of the year of grant and the expiration date (*exdate*) reported in its proxy statement. The nominal term is further rounded to the nearest year figure. However, the option's term was reduced to 70% of its nominal term as directors rarely hold its stock option until its expiration year. The expiration date is not available on Execucomp for post-2006 reporting format. Therefore, I follow Kini and Williams (2012) to assume all options have seven years until expiration.
4. Risk-free rate. The risk-free rate corresponding to the option's maturity is the historical annual series of treasury constant maturity with 7-year term downloaded from the Federal Reserve website[37].
5. Stock price volatility. Individual stock price volatility is the annualised volatility calculated using the last 60 months. The stock volatility of all companies is winsorised at the top and bottom 5%. To calculate the volatility, Execucomp requires at least 12-month return data. For stocks that are traded less than 12 months, Execucomp the average volatility value for the firms in the S&P 1500 index.

[36] My results remain robust if I do not correct for the FSBA change and use raw figures reported by Execucomp.
[37] https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15

6. Future dividend yield. Execucomp uses the average dividend yield in the last three years to calculate the estimated future dividend yield. The dividend yield is winsorised at the top and bottom 5%.

Using these assumptions, I replicate the Black-Sholes option value for 2005, and the correlation between my Black-Sholes value and the Black-Sholes value calculated by Execucomp is 95.9%[38]. I further recalculate all option awards for both pre- and post-2006 period by using the same set of Black-Sholes assumptions to ensure consistency. Secondly, I follow Brockman *et al.* (2016) to value the ex-ante value of stock awards. I multiply the number of performance shares granted to the CEO (*shrtarg*) by the firm's fiscal year-end stock price (Compustat *prcc_f*). Finally, I recalculate the *tdc1* for all firm-year observations that reported in the pre-2006 old format (item *old_datafmt_flag=1*) by summing salary (*salary*), to bonus (*bonous*), other annual compensation (*othann*), restricted stock grant (*rstkgrnt*), all other total (*allothtot*), the fair value of stock awards (*shrtarg*×*prcc_f*) and Black-Scholes value of option grant (*option_awards_blk_value*). For *tdc1* reported in post-2006 new format (item *old_datafmt_flag=0*), I sum salary (*salary*), bonus (*bonous*), non-equity incentive plan compensation (*noneq_incent*), fair value of stock awards (*stock_awards_fv*), all other compensations (*othcomp*), deferred earnings (*defer_rpt_as_comp_tot*) and Black-Scholes value of option grant.

To build a link table between Execucomp and Smart Insider, I first obtain all its historical cusip codes using the CRSP/Compustat link table. Second, for a given director in Execucomp, I match the director with all the directors who have traded the security with the same cusip. Third, I calculate the Damerau-Levenshtein (DL) distance and vectoral decomposition (VD) of texts with single gram and root weighting scheme between the name of the director provided by Execucomp and reported by Smart Insiders. I sort these matches by DL distance and VD score to manually verify each pair of *execid-personid* match.

To identify short horizon seller, I modify the investment horizon measure proposed by Akbas, *et al.* (2020). Firstly, I define HOR as:

$$HOR_{i,j,t} = \frac{\sum_{Year-8}^{Year-1} NPV_t}{N}$$

That is, for each year, I compute the annual NPV for each insider *i* in firm *j* in year *t* in the last eight calendar years. Then, I compute the average NPV by summing the annual NPV and divide by the number of calendar years that an insider has traded in the last eight calendar years. HOR can only take a value between -1 and +1, which are the bounds of the NPV. If an insider only sold (bought) in the last eight years, then each of its NPV is -1 (1), and therefore, the average will be -1 (1) as well. I define SH sellers as those whose $HOR_{i,j,t}$ is negative but larger than the median $HOR_{i,j,t}$ after excluding the

[38] Kini and Williams (2012) report a correlation of 96.8% for 2005. The difference is possibly due to different risk-free rate sources, which they do not report.

$HOR_{i,j,t}$ of -1 which accounts for more than 50%of the insider sell sample. I restrict SH sellers must have traded at least in three different years in the past eight years.

I follow Tucker and Zarowin (2006) and Wang (2019) to construct the FERC by first estimating the following equation:

$$R_{i,t} = \alpha + \beta_0 X_{i,t-1} + \beta_2 X_{it} + \beta_3 \left(X_{i,t+1} + X_{i,t+2} + X_{i,t+3}\right) + \beta_3 R_{i,t+3} + \varepsilon_{i,t}$$

where $X_{i,t}$ is the basic annual earnings per share excluding extraordinary items (*epspx*), adjusted for stock splits and stock dividends and deflated by the stock price at the beginning of the fiscal year *t*. $R_{i,t}$ is the firm's annual return beginning at the fiscal year *t* and $R_{i,t+3}$ is a three-year future return for the firm from fiscal year *t+1* to *t+3*. The coefficient of the sum of the future three-year earnings per shares β_3 is the FERC. I truncate all variables at the top and bottom 1%. A higher β_3 means the current stock return impounds more future earnings information and is more informative for future earnings and *vice versa.* I follow Wang (2019) to estimate a rolling panel regression using the trailing 36 months across each two-digit SIC industry. I restrict that there are at least 8 (24) months in $R_{i,t}$ ($R_{i,t+3}$) for a stock to be included in the regression and create binary variable FERC that is one for the top quintile of the β_3 and zero otherwise.

I use the stock return synchronicity used by Piotroski and Roulstone (2004) estimated from the following equation:

$$\mathrm{FirmRET_{i,t}} = \alpha + \beta_1 \mathrm{MktRET_{j,t}} + \beta_2 \mathrm{MktRET_{j,t-1}} + \beta_3 \mathrm{IndRET_{k,t}} + \beta_4 \mathrm{IndRET_{k,t-1}} + \varepsilon_{i,t}$$

where $MktRET_{j,t}$ is the market return proxied by the CRSP value-weighted buy-and-hold market return in year t. $IndRET_{k,t}$ is the value-weighted average industry buy-and-hold return identified using the two-digit SIC code in year *t*. I estimate the regression for each firm-year observation with weekly return data and restrict a minimum of 45 weekly observations each year. The synchronicity is measured as $\ln\left(\frac{R^2}{1-R^2}\right)$. The R^2 is the R square of the above regression. A higher $Synch_{i,t}$ indicates the current firm return comove strongly with the current and lagged market and industry returns, which further indicates the stock price contains less firm-specific information.

To measure the change in investor sentiment denoted as $\Delta Sentiment$, I compute the market-to-book ratio decomposition of Rhodes–Kropf, Robinson and Viswanathan (2005) defined as the residual from the following regression

$$\ln(\mathrm{market\_value})_{i,t} = \alpha + \beta_{1j,t} \ln(\mathrm{book\_value})_{i,t} + \beta_{2j,t} \ln(\mathrm{net\_income})^{+}_{i,t} + \beta_{3j,t} I_{(<0>)} \ln(\mathrm{net\_income})^{+}_{i,t} + \beta_{4j,t} \mathrm{leverage}_{i,t} + \varepsilon_i$$

where subscript *j* indexes for Fama-French 12 industries, *i* for firms and *t* for year. I estimate the regression for each industry-year. $I_{(<0>)}$ is a dummy variable equal to one for loss-making firms, and

zero otherwise. The firm-specific residual obtained from the regression is the part of the firm's market value not explained by fundamentals or by changes in the market valuation common across firms in the same industry. I follow Cziraki *et al.* (2021) to measure the change in sentiment between $(t-1, t+1)$ with year *t* as insider trading year.

To measure the change of cost of capital, I estimate the following modified Fama and French (1993) three-factor model by following Cziraki, *et al.* (2021)

$$r_{i,t}\text{-}r_{f,t}=\alpha_{\text{-}i}+\alpha_{\Delta i}D_t+b_{\text{-}i}(r_{m,t}\text{-}r_{f,t})+b_{\Delta i}D_t(r_{m,t}\text{-}r_{f,t})+s_{\text{-}i}SMB_t+s_{\Delta i}D_tSMB_t+h_{\text{-}i}HML_t+h_{\Delta i}D_tHML_t+e_t$$

where $r_{i,t}$ is the monthly stock return, $r_{f,t}$is the return on 1-month U.S Treasury bill, $r_{m,t}$ is the CRSP value-weight market index, SMB_t and HML_t are the returns on the size and book-to-market ratio portfolios. D_t is a dummy variable that equals one if the year is in $(0,1)$, and zero for years in $(-3,-1)$. I use years $(-3,2)$ to estimate the cost of capital prior and after the CEO turnover. The expected change of cost of capital is obtained using the estimated coefficient of $\hat{\alpha}_{\Delta i}$ plus the product between $\hat{b}_{\Delta i}$, $\hat{s}_{\Delta i}$, $\hat{h}_{\Delta i}$ and the corresponding average factor premium estimated using all firms in CRSP database between 1993 and 2019[39].

$$\Delta r_{t,t+2} = \hat{\alpha}_{\Delta i}+ \hat{b}_{\Delta i}\overline{(r_{m,t}\text{-}r_{f,t})}+ \hat{s}_{\Delta i}\overline{SMB_t}+\hat{h}_{\Delta i}\overline{HML_t}$$

[39] The average factor premium in my sample is 0.007 for $\overline{(r_{m,t}\text{-}r_{f,t})}$, 0006 for $\overline{SMB_t}$ and 0.002 for $\overline{HML_t}$

Appendix 2: Sample size across different database

	Unique *execid*	Unique *personid*	Sample Size
Raw Execucomp Sample	48,429		269,456
Match with *execid-personid* link table	43,952	44,187	277,113
Match with CRSP both insider purchase and sale, including CEO	26,570	26,617	257,033
Match with CRSP both insider purchase and sale, excluding CEO	24,275	24,310	188,960
Remove new joiner, previous CEO, co-founders/founders	21,723	21,764	165,705
Valid insider purchase sample for Non-Promoted Director in (0,0)	536	537	860
Valid insider purchase sample for Non-Promoted Director in (0,1)	844	845	1,492
Valid insider sell sample for Non-Promoted Director in (0,0)	3,107	3,110	7,935
Valid insider sell sample for Non-Promoted Director in (0,1)	4,527	4,532	15,443

Appendix 3: Definition of Variables

Variable Notation	Data Source	Definition
$BHAR\_m\_365_{(d+1,\ d+365)}$	CRSP	365-calendar day Buy-N-Hold return adjusted by using the CRSP value-weighted market index. Defined as the following: $BHAR_{m_n} = \prod_{t=1}^{d}[1 + R_{jt}] - \prod_{t=1}^{d}[1 + R_{mt}]$
$NPV_{i,d}$	Smart Insider	Net purchasing value for insider transactions in day *t* executed by insider *i*, calculated as the ratio of the net dollar amount of insider transactions over the total dollar amount of insider transactions. If *NPV_i* is greater (less) than 0, I recognise that the insider *i* is net buying (selling) on a given day *d*.
$opp\_D_{i,t}$	Smart Insider	Dummy variable equal to one for opportunistic insider transactions, and zero otherwise. I identify opportunistic transactions by following Cohen *et al.* (2012), that is the transaction executed by insiders who had made at least one transaction in the same calendar year in the past three consecutive years. Other insiders are routine traders. I reclassify each insider at the beginning of each calendar year.
$NPED_{i,t}$	Execucomp	Dummy variable equals one for insider purchase or sell transactions executed by non-promoted director in the event year *t* zero for years other than *t*. *t* takes the value of 0, 1 in the study.
$pay\_gap_{j,t-1}$	Execucomp	The natural logarithm of the difference between the CEO total compensation (*tdc1*) and the median total compensation of other non-CEO directors covered by Execucomp in firm *j* in the last fiscal year. *tdc1* is adjusted by following Coles *et al.* (2014) and Brockman *et al.* (2016).
$lncompen_{j,t-1}$	Execucomp	The natural logarithm of *tdc1* adjusted by following Coles *et al.* (2014) and Brockman *et al.* (2016).
$rating_{j,\ t-1}$	Compustat	The average monthly S&P long-term issuer credit rating of firms in the same Fama-French 48 industry in the last fiscal year.
$high\_incentiveD_{i,t-1}$	Execucomp	A dummy variable that is equal to one for high incentive directors, and zero otherwise. High incentive directors are defined as those directors *i* whose compensation differences between their CEOs and themselves are the largest three in firm *j* in year *t-1*.

$Pay\_rank_{i,t-i}$	Execucomp	The rank of non-promoted director sorted by their total compensation in year -1 among all tournament competitors in the same firm.
$mom_{j,(d-31,d-364)}$	CRSP	The cumulative raw return from (d-395, d-31), insider transaction occurs in day d. If there are less than 243 trading days in the event window, the variable is set to be missing.
$ret30_{j,(d-1,d-30)}$	CRSP	The cumulative raw return from (d-30, d-1), insider transaction occurs in day d. If there are less than 20 trading days in the event window, the variable is set to be missing.
$bm_{j,m-1}$	CRSP, Compustat	The book-to-market ratio calculated as the ratio of last fiscal year's book value over the market capitalisation in the last trading day in December. Book value is computed as the following. Book value is equal to stockholder equity + deferred taxes and investment tax credit (Compustat: txditc, zero if missing) − preferred stock value. Stockholder equity is parent stockholder equity (Compustat: seq), or total common equity (Compustat: ceq) plus total preferred stock capital (Compustat: pstk) or the difference between the total asset (Compustat: at) and total liability (Compustat: lt), in that order, as available. Preferred stock value is the preferred stock redemption value (Compustat: pstkrv), or preferred stock liquidation value (Compustat: pstkl), or total preferred stock capital (Compustat: pstk), or zero, in that order as available. Negative bm ratio is restricted to zero. The ratio is calculated for firm *j* at the end of the last month.
$leverage_{i,t}$	Compustat	Long term debt plus debt in current liability) over the total assets $\frac{(dltt + dlc)}{at}$
$illiq_{j,m-1}$	CRSP	Amihud's (2002) measure of illiquidity for firm *j* at the end of the last month. The measure is calculated as the monthly average of the daily ratio of absolute stock return to dollar volume.
$size_{j,m-1}$	CRSP	The logarithm of market capitalisation defined as adjusted stock price times adjusted shares outstanding for firm *j* at the end of the last month. The number is reported in a million.

$roa_{j,t-1}$	Compustat	Return on asset calculated as the net income (Compustat: ni) after taking out preferred dividend (Compustat: dvp), over the total asset (Compustat: at) for firm *j* at the end of the last fiscal year.
$age\_ceo_{j,\ t-1}$	Execucomp	In the fiscal year *t-1*, *I* identify the former CEO of firm *j*. The variable is her age in year *t-1*. If Execucomp does not report the age of director in a given year, I use the age of the same director in other years to complete the age of the director in the year.
$numest_{j,m-1}$	I/B/E/S	Analyst coverage is defined as the number of analysts that report a forecast for the next 1-fiscal year earnings per share for firm *j* at the end of the last month. If there is no earning forecast, the analyst coverage is set to be zero.
$rd_{j,t-1}$	Compustat	Research and development expense calculated as the research and development expense (Compustat: xrd) over sales (Compustat: sale) for firm *j* at the end of the last fiscal year. If Compustat reports missing research and development expense, it is set to be zero.
$delta_{i,t-1}$	Execucomp	Dollar change in wealth associated with a 1% change in the firm's stock price (in $000) for director *i*. Calculated according to Coles *et al.* (2013).
$vega_{i,t-1}$	Execucomp	Dollar change in wealth associated with a 0.01 change in the standard deviation of the firm's returns (in $000) for director *i*. Calculated according to Coles *et al.* (2013).
$OutsiderD_{i,j}$	Execucomp	If the new CEO had not been working in the company in the last 5 years of the CEO turnover, the CEO is defined as outsiders. The dummy takes the value of one for insider transactions for firms with outside CEO appointment during the year $(0, 1)$, and zero otherwise.
$COOD_{i,j}$	Execucomp	If the firms had a COO and the COO is younger than the current CEO before the CEO tournament, the firm is defined as COO firm. The dummy takes the value of one for non-promoted insider transactions for COO firms during the year $(0, 1)$, and zero otherwise. I define COO is the director who is younger than the incumbent CEO and whose job title (*titleann*) contains *chief operating office* or *chief operation officer* or *chief operations officer* or *chf operations officer* or *chf operation officer* or *che*

		operating officer or *coo* or *president* or/and *pres*
$CEO\_IT_{j,t}$	Execucomp, Smart Insider	The number of quintiles of the net CEO selling value for firm *j* in year *t*. Net CEO selling value is the total value of selling transaction minus the total value of buying transaction executed by CEO in year *t* for firm *j*. If there is no CEO insider transaction in year *t*, the number is set to be 0.
$lnage_{j,t}$	Execucomp	The natural logarithm of the current age of the director *i* in year *t*.
total $asset_{j,t-1}$	Compustat	Logarithm of the total asset (Compustat: at) in the last fiscal year. The variable is only used to conduct the matching only.
$FERC_{j,t}$	CRSP, Compustat	It is a dummy variable equal to one for firms in the top quantile of future earnings response coefficient calculated accorindg to Tucker and Zarowin (2006), and zero for other firms.
$Synch_{j,t}$	CRSP	It is a dummy variable equal to one for firms in the top quantile of return synchronicity calculated accorindg to Piotroski and Roulstone (2004), and zero for other firms.
tobin's $Q_{i,t-1}$	Compustat	Market value of equity plus book value of debt-deferred tax over book value of total assets. $\frac{(at + csho \times prcc\_f - ceq - txdb)}{at}$
capital-to-$sale_{j,t-1}$	Compustat	Net fixed asset (Compustat: ppent) to sales (Compustat: sale).
advertising-to-$sale_{j,t-1}$	Compustat	Advertising expenditure (Compustat: xad) to sales (Compustat: sale). It is assumed to be zero if firms do not report advertising expenditure.
dividend-$yield_{j,t-1}$	Compustat	The dividends per share by ex-date divided (Compustat: dvpsx_f) by the close price for the fiscal year (Compustat: prcc_f).
$all\_IT_{j,t}$	Smart Insider	The total number of non-CEO insider transaction for firm *j* in year *t*. If there is no non-CEO insider transaction in year *t*, the number is set to be 0.
$sale_{j,t-1}$	Compustat	The natural logarithm of the sale (Compustat: sale).
$skt\_ret\_volatility_{i,t-1}$	CRSP	Variance of 60 monthly returns preceding the sample year *t-1*
$capital\_intensity_{i,t-1}$	Compustat	Capital expenditure (Compustat: capx) over total asset (Compustat: sale)
$firm\_focus_{i,t-1}$	Compustat-Segment	Firm focus is computed as the segment sales-based Herfindahl index. I use Compustat segment file to identify a firm's segment sales according to their

		four-digit SIC code. Firm focus is equal to one if the firm operates only in one segment and decreases as the firm diversifies. (Kini and Williams, 2012)
$cash\_flow\_vol_{i,t-1}$	Compustat-Quarterly	It is the seasonally adjusted standard deviation of cash flows over assets for a five-year window (*t*, *t+4*). I require there are at least a three-year data to compute this variable. Quarterly cash flows over assets is defined as the EBITD (Compustat: saleq- cogsq- xsgaq) over total asset (Compustat: atq). For each of the four quarters in the year, I compute the mean values across the five-year window and then subtract these quarterly mean values to obtain the seasonally adjusted cash flows. I then compute the standard deviation of these adjusted cash flows over assets over the period *t* to *t+4*. (Kini and Williams, 2012)
$institution\_ownership_{j,q-1}$	Thomson Reuter 13F Holding	Percentage of shares owned by institution investors over total shares outstanding in the last quarter.
$independent\_director_{j,t-1}$	Boardex	Percentage of independent directors on the company board.
$independent\_committee_{j,t-1}$	Boardex	Percentage of independent directors on the company compensation committee.
$analyst\_talent_{j,t-1}$	I/B/E/S	The average talent of financial analysts that cover firm *j* in the last fiscal year. It is the innate ability of sell-side analysts measured by the analyst fixed effect from the regression on analysts' forecast accuracy. Calculated according to Dang *et al.*, (2021)
$\alpha_{t+1,t+i}$	CRSP, French Data Library	The intercept calculated by running regression $r_{i,t} - rf_t = \alpha_{i,t} - \beta_1(r_{crsp,t} - rf_t) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 UMD_t + \varepsilon_t$ from the day after insider transaction day to 30/180/365 calendar day. rf_t is the risk-free rate, $r_{crsp,t}$ is CRSP value-weighted market index, SMB_t is small-minus-big factor (size), HML_t is high-minus-low factor (value), and UMD_t is up-minus-down factor (momentum).
$CEO\_tenure_{j,t-1}$	Execucomp	Computed as the difference between year *t* and the year the director became CEO (Execucomp:*becameceo*). If the *becameceo* is missing, it is the number of yearly observations the director has become CEO.

Appendix 4: Test on Parallel Trend Assumption

I follow Angrist and Pischke (2009) and Cengiz *et al.* (2019) to conduct an event-study type diff-in-diff regression and formally test on the parallel trend assumption. Variable Pre_t equal to 1 for treated firms in year *t*, and zero otherwise. Year *t* refers to the year in my event window with year *0* as the CEO turnover occurred. Variable $Post_t$ is defined with the same logic. The coefficients of Pre_{-1} should be statistically insignificant for the parallel trend assumption to hold. Pre_{-2} is omitted to avoid perfect multicollinearity. Column (1) and (2) focuses on insider purchase and sell transactions, respectively. I control for firm, year, and event fixed effects. Standard errors are clustered at the firm-month level. ***, **, and * denote significance at the 99%, 95% and 90% confidence level, respectively. All variables are winsorised at the top 99% and the bottom 1% level.

	Purchase Transactions	**Sell Transactions**
	(1)	(2)
	BHAR_m_365	BHAR_m_365
Pre_{-1}	0.108	-0.030
	(0.080)	(0.019)
$Post_0$	0.211*	-0.061**
	(0.119)	(0.026)
$Post_1$	0.079	-0.082***
	(0.151)	(0.032)
$CEO\_IT_{i,t}$	0.031	0.010**
	(0.025)	(0.004)
$OutsiderD_{i,j}$	0.138	0.053*
	(0.125)	(0.032)
$COOD_{i,j}$	-0.169	0.055*
	(0.115)	(0.031)
$high\_incentiveD_{i,t-1}$	0.027	-0.001
	(0.021)	(0.005)
$pay\_gap_{j,t-1}$	-0.024	-0.006
	(0.016)	(0.005)
$ret30_{j,t,(d-1,d-30)}$	-0.418***	-0.249***
	(0.102)	(0.033)
$mom_{j,\ t,(d-31,d\ -364)}$	-0.058	0.031
	(0.059)	(0.022)
$bm_{j,m-1}$	-0.064	-0.028
	(0.056)	(0.045)
$numest_{j,m-1}$	-0.012	-0.003
	(0.011)	(0.003)
$illiq_{j,m-1}$	0.065**	0.291*
	(0.028)	(0.153)
$size_{j,m-1}$	-0.732***	-0.669***
	(0.097)	(0.037)
$roa_{j,t-1}$	-0.415	0.366**
	(0.425)	(0.171)
$delta_{i,t-1}(\times 0.01)$	0.129**	0.001
	(0.063)	(0.001)
$vega_{i,t-1}(\times 0.01)$	-0.230**	-0.015**
	(0.111)	(0.008)
$rd_{j,t-1}$	0.910	0.386
	(0.821)	(0.282)
$lncompen_{j,t-1}$	0.057**	0.024**
	(0.025)	(0.010)
$rating_{i,t-1}$	0.636	-0.345
	(1.120)	(0.217)
Constant	3.700**	5.854***
	(1.689)	(0.449)
Sample	2,309	47,094
Within R^2	0.38	0.30

Appendix 5: Insider trading and price informativeness around the CEO turnover

This table reports the fixed effects regression output based on the matched sample. Firms that have CEO turnover event in year *t* are matched with firms on the average insider purchase/sell profitability, logarithm of the total asset and the book-to-market ratio in the fiscal year *t-1*. The distance is calculated by using Mahalanobis distance. Each treated firm is matched with one control firm. I restrict that the control firm sample does not have any CEO turnover in (-2, 2). In Panel A, the moderator variable is the future earnings response coefficient (FERC) calculated according to Tucker and Zarowin (2006) and the $NPED_{i,t}$. $FERC_{i,t}$, is a dummy variable equal to one for firms in the top quantile of $FERC_{I,t}$ in year *t*, and zero otherwise. In Panel B, the moderator variable is the return synchronicity (Synch) calculated according to Piotroski and Roulstone (2004). $Synch_{i,t}$ is a dummy variable equal to one for firms in the top quantile of $Synch_{I,t}$ in year *t* in the same two-dig sic industry, and zero otherwise. Appendix 3 defines all variables in the table. For years in the post turnover period other than year *t*, it is not included in these regressions. I state the year t at the top of the table. I include the same set of control variables as in Equation (2). Standard errors reported in parentheses are computed based on robust standard errors clustered at the firm-month level. ***, **, and * denote significance at the 99%, 95% and 90% confidence level, respectively. All variables are winsorised at the top 99% and the bottom 1% level.

	Panel A: Future Earnings Response Coefficient			
	Insider Purchase		Insider Sell	
	(1)	(2)	(3)	(4)
Year *t*	(0,0)	(1,1)	(0,0)	(1,1)
Dependent Variable	BHAR_m_365	BHAR_m_365	BHAR_m_365	BHAR_m_365
$Post_{i,t}$	0.125	0.037	0.016	0.037***
	(0.055)	(0.085)	(0.011)	(0.013)
$Treat_{i,t}$	-0.337***	-0.196	0.002	-0.002
	(0.113)	(0.121)	(0.012)	(0.012)
$(Treat \times Post)_{i,t}$	0.163*	0.196	-0.036**	-0.034*
	(0.095)	(0.124)	(0.018)	(0.020)
$FERC_{i,t}$	-0.117	0.057	-0.029	-0.013
	(0.115)	(0.112)	(0.020)	(0.023)
$(Post \times Treat \times FERC)_{i,t}$	-0.011	-0.095	0.099***	0.029
	(0.186)	(0.179)	(0.036)	(0.047)
Other control variable and main levels	Yes	Yes	Yes	Yes
Sample	1,400	1,079	30,879	28,415
			Panel B: Return Synchronicity	
	Insider Purchase		Insider Sell	
Year *t*	(0,0)	(1,1)	(0,0)	(1,1)
Dependent Variable	BHAR_m_365	BHAR_m_365	BHAR_m_365	BHAR_m_365
$Post_{i,t}$	0.005	0.119	0.014*	0.031**
	(0.069)	(0.126)	(0.011)	(0.013)

$Treat_{i,t}$	-0.311***	-0.215*	0.016	0.012
	(0.114)	(0.116)	(0.013)	(0.012)
$(Treat \times Post)_{i,t}$	0.234**	0.011	-0.031**	-0.038**
	(0.103)	(0.170)	(0.019)	(0.019)
$Synch_{i,t}$	0.040	0.001	0.021	-0.013
	(0.084)	(0.080)	(0.013)	(0.017)
$(Post \times Treat \times Synch)_{i,t}$	-0.142	0.222	0.028	0.014
	(0.136)	(0.191)	(0.033)	(0.040)
Other control variable and main levels	Yes	Yes	Yes	Yes
Sample	1,828	1,323	31,131	28,542

Appendix 6: 2SLS regression result for matching sample

Appendix 6 reports the regression output of 2SLS regression on sample obtained by nearest neighbour matching. The dependent variable in the first stage of the regression is $NPED_{,I,t}$. It is dummy variable that equals to one for the purchase/sell transactions of promotion rejectees in $(0,0)$ and $(1,1)$ with year 0 as the CEO turnover event depending on the year *t*. $NPED_{,I,t}$ is equal to zero for years outside the event window and $(-2,-1)$. For years in the post turnover period other than year *t*, it is not included in the regression. I state the year t at the top of the table. In all columns, the sample is obtained by the nearest neighbour matching. Firms that have CEO turnover event in year *t* are matched with firms on the average insider purchase/sell profitability, logarithm of the total asset and the book-to-market ratio in the fiscal year *t-1*. The distance is calculated by using Mahalanobis distance. Each treated firm is matched with one control firm. I restrict that the control firm sample does not have any CEO turnover in (-2, 2). My instrumental variable is the previous CEO's age in the last fiscal year. I include the same set of control variables as in Equation (2). Standard errors reported in parentheses are computed based on robust standard errors clustered at the firm-month level. ***, **, and * denote significance at the 99%, 95% and 90% confidence level, respectively. All variables are winsorised at the top 99% and the bottom 1% level.

	Insider Sell	
	(1)	(2)
	First Stage	
Year *t*	(0,0)	(1,1)
Dependent Variable	$NPED_{i,t}$	$NPED_{i,t}$
$age\_ceo_{i,t-1}$	0.019^{***}	-0.023^{***}
	(0.002)	(0.002)
Control Variable	Yes	Yes
	Second Stage	
Dependent Variable	BHAR_m_365	BHAR_m_365
Endogenous Variable		
$\widehat{NPED}_t$	-0.543^{*}	-1.132^{**}
	(0.309)	(0.467)
$\widehat{NPED \times CEO\_IT}_{i,t}$	0.564^{***}	0.331^{**}
	(0.200)	(0.157)
Control Variables		
$CEO\_IT_{i,t}$	0.004	-0.024
	(0.011)	(0.016)
Other Control Variable	Yes	Yes
Sample	18,368	18,831
Fixed Effect	Firm, Month	Firm, Month
Difference in Sargan *C* (χ^2)	37.23^{***}	18.35^{***}
First-Stage F-$\widehat{NPED}_{I,t}$	163.75^{***}	225.09^{***}
Anderson-Rubin Wald Test, F-Statistics	20.82^{***}	8.71^{***}

Appendix 7: Insider trading and the probability of becoming CEO

This table reports linear probability models estimating the likelihood of a director *i* becomes CEO in year *t*. The dependent variable equals one for CEO, and zero otherwise. Regressions are estimated using all tournament competitors defined previously and for CEO turnover year *t* only. Sample is at director-firm level. Variables $no\_buy_{I,t-1}$ and $no\_sell_{I,t-1}$ represent the number of insider purchase and sell transactions made by insiders *i* in year *t-1*. $Age_{I,t-1}$,$tenure_{I,,t-1}$ represents the age and tenure of insiders *i* in year *t-1*, respectively. $COOD_{I,t-1}$ is a dummy variable equals to one if the director *i* is chief operating officer or president in year *t-1*, and otherwise zero. All other variables are defined in Appendix 3 and winsorised at the 1% level. I include firm and year fixed effects; standard errors are clustered by firm and reported within brackets below the corresponding coefficient estimate. ***, **, and * denote significance at the 99%, 95% and 90% confidence level, respectively.

	(1)	(2)
	$CEOD_{i,t}$	$CEOD_{i,t}$
$age_{i,t-1}$	-0.005**	-0.004**
	(0.002)	(0.002)
$tenure_{i,,t-1}$	0.006*	0.006*
	(0.003)	(0.004)
$COOD_{i,t-1}$	0.435***	0.434***
	(0.032)	(0.032)
$no\_buy_{i,t-1}$	0.044	0.041
	(0.027)	(0.028)
$no\_sell_{i,t-1}$	-0.006	-0.005
	(0.004)	(0.005)
$no\_buy_{i,t-2}$		0.009
		(0.033)
$no\_sell_{i,t-2}$		-0.000
		(0.006)
$delta_{i,t-1}$(×0.01)	0.012**	0.012**
	(0.006)	(0.006)
$vega_{i,t-1}$(×0.01)	0.062**	0.061**
	(0.031)	(0.031)
$lncompen_{i,t-1}$	0.000***	0.000***
	(0.000)	(0.000)
$ret30_{j,t-1,(d-1,d-30)}$	0.522***	0.525***
	(0.167)	(0.167)
$mom_{j,\ t-1,(d-31,d\ -364)}$	0.036	0.036
	(0.054)	(0.054)
$bm_{j,t-1}$	0.132*	0.131*
	(0.075)	(0.075)
$illiq_{j,t-1}$	0.038	0.040
	(0.076)	(0.076)
total $asset_{j,t-1}$	-0.118***	-0.118**
	(0.046)	(0.046)
$roa_{j,t-1}$	-0.113	-0.113
	(0.213)	(0.212)
tobin's $Q_{j,t-1}$	0.017	0.017
	(0.020)	(0.021)
$leverage_{j,t-1}$	0.059	0.057
	(0.130)	(0.130)
Constant	0.880**	0.880**
	(0.401)	(0.404)
Sample	1,364	1,364
Fixed Effect	Firm, Year	Firm, Year
Within R^2	0.45	0.45