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Clawback adoptions, managerial compensation incentives, capital investment mix and efficiency

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ABSTRACT

We present evidence that clawback adoptions, by dissuading accruals management, motivate managers to shift capital investment mix from R&D to capex to preserve earnings-based compensation, thereby lowering capital investment efficiency. These effects are more pronounced for firms prone to financial misreporting, which is consistent with board incentives to adopt clawbacks, and with managerial incentives to substitute real for accruals-based earnings management to preserve performance-based compensation. Path analyses lend support to performance-based compensation serving as a channel through which clawback adoptions influence capital investment mix and efficiency. These findings extend and reinterpret prior findings and are timely given the Security and Exchange Commission's newly issued Rule 10D-1 that makes clawback provision adoptions a condition for U.S. exchange listings and explicitly requested "comment on any effect the proposed requirements may have on efficiency, competition, and capital formation."

1. Introduction

Prior evidence indicates that clawback provision adoptions dissuade accruals-based earnings management as proponents argue.[1] This study provides evidence that in response to clawback adoptions, performance-based compensation motivates managers (CEOs) to substitute real for accruals-based earnings management by way of capital investment mix shifts from R&D to capital investments (capex) that raise earnings and lower capital investment efficiency. These effects of clawback adoptions are more pronounced for firms prone to financial misreporting, which is consistent with board incentives to adopt clawback provisions and with CEO incentives to

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[1] Clawback provisions adopted by company boards recoup performance-based executive compensation based on earnings that are subsequently restated.

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employ real earnings management to preserve performance-based compensation. Path analyses lend support to performance-based compensation serving as a channel through which clawback adoptions influence capital investment mix and efficiency. These results extend and reinterpret prior findings and are timely given the recent issuance of Securities and Exchange Commission (SEC) Rule 10D-1 (SEC, 2022) that makes the adoption of clawback provisions a condition for U.S. exchange listing, and which explicitly requested "comment on any effect the proposed requirements may have on efficiency, competition and capital formation" (SEC, 2015, 103–104; Kiernan, 2022).

Prior research confirms that clawback adoptions discourage earnings management and enhance financial reporting quality, which are purported clawback benefits (e.g., Chan et al., 2012; Dehaan et al., 2013). Prior research further finds a positive association between financial reporting quality and capital investment efficiency (e.g., Biddle and Hilary, 2006; Biddle et al., 2009), including for clawback adoptions (Liu et al., 2018). However, other studies argue that clawback adoptions motivate CEOs to increase their use of real earnings management, which is less subject to clawback-triggering restatements than accrual-based earnings management.[2] Of particular interest is the Chan et al. (2015) finding that clawback adoptions induce CEOs to reduce discretionary expenses, including R&D expenses, which are essentially equivalent to R&D capital investments under U.S. Generally Accepted Accounting Principles (GAAP).[3] Chan et al. (2015) attribute this effect to incentives to meet or beat earnings targets by firms with high growth and transient institutional ownership.[4] Subsequent studies argue alternatively that clawback adoption effects on R&D capital investment relate to governance, risk and overinvestment mitigation (Chen and Vann, 2017; Liu et al., 2020; Babenko et al., 2023). These differing interpretations raise questions regarding the channels through which clawback adoptions influence capital investment decisions.

A possible channel by which clawback adoptions could influence capital investment decisions is suggested by the effects on performance-based executive compensation of the differing earnings payback patterns of capital investment components. In particular, reducing R&D investment boosts near-term earnings at the cost of less predictable longer-term earnings. By comparison, capex investments boost near-term earnings by expanding current operations at the cost of formulaic long-term depreciation (Kothari et al., 2002; Amir et al., 2007; Canace et al., 2018).[5] Applying well-established findings that performance-based executive compensation motivates accrual-based earnings management (e.g., Healy, 1985; Guidry et al., 1999; Cheng and Warfield, 2005; Graham et al., 2005; Bergstresser and Philippon, 2006; Burns and Kedia, 2006; Benmelech et al., 2010; Shalev et al., 2013) and the Chan et al. (2015) finding that CEOs respond to clawback adoptions by substituting real for accrual-based earnings management, we reason that clawback adoptions will motivate investment mix shifts from R&D to capex to preserve performance-based pay. The Benmelech et al. (2010) finding that stock-based compensation motivates CEOs to choose investment policies that hide negative earnings news implies like incentives for R&D to capex investment mix shifts to preserve growth perceptions and stock valuations.

Shifts in capital investment mix also have the potential to reduce capital investment efficiency, thus mitigating or offsetting gains in investment efficiency arising from improvements in financial reporting quality due to clawback provision adoptions (e.g., Biddle et al., 2009; Kim and Wei, 2021). Therefore, we also examine whether performance-based compensation incentives serve as a channel through which clawback adoptions reduce capital investment efficiency, which SEC Rule 10D-1 (SEC, 2015) foreshadowed as a possibility.

We test these propositions using a propensity score matched sample of 1257 firm-years surrounding 136 voluntary clawback adoptions by R&D intensive firms between 2005, when Section 304 of the Sarbanes–Oxley Act sanctioned clawbacks, and 2012, when the Dodd–Frank Act specified their requirement thereby influencing related incentives. Our R&D intensive sample focuses on manufacturing firms (86.9%) that more routinely make R&D and capex investments compared with firms in other industries. Our results, after controlling for other determinants, reveal statistically significant reductions (increases) in R&D (capex) investments following clawback adoptions for firms with higher levels of performance-based annual pay and equity incentives as predicted. We further find that clawback adoptions are negatively associated with investment *q* sensitivity (Chen et al., 2007; Peters and Taylor,

[2] Chan et al. (2015) argue that "real" earnings management is less likely to be viewed as improper than accrual-based earnings management by boards, regulators, and auditors (Ewert and Wagenhofer, 2005; Graham et al., 2005; Roychowdhury, 2006; Cohen et al., 2008). Corroborative evidence is provided by Bao et al. (2018), who report an increase in share price crash risk following clawback adoptions that is more prominent for firms with more real activity manipulation and 10-K report opacity than for other firms.

[3] Alternatively, managers may rebalance the amounts and timing of R&D budgets between R&D staffing costs (expensed as incurred) and R&D laboratory equipment or property (capitalized and depreciated over their useful life) (Canace et al., 2018). Managers may also boost short-term earnings by misclassifying R&D expenses as capex. However, such misclassifications may violate accounting standards and activate clawback-triggering restatements.

[4] Canace et al. (2018) find evidence of investment mix shifts from R&D to capex to meet earnings targets but do not consider clawback adoptions or effects on capital investment efficiency.

[5] Managers can shift R&D expenditure from R&D staffing costs (immediately expensed) to R&D laboratory equipment or property (capitalized and depreciated over their useful life), which would bias against our findings. Alternatively, firms can acquire R&D. However, relative to capex, R&D acquisition requires enabling liquidity and lead time for integration and/or implementation. We reason that clawback adoptions reduce the likelihood of managers boosting short-term earnings by misclassifying R&D expenses into capex without changing actual R&D activities because such misclassifications could be subject to restatements that may trigger clawback provisions if detected.

2017) and with the research quotient measuring the ability of R&D to generate future revenue (Knott, 2008).[6] In addition, we find that shifts in capital investment mix from R&D to capex are more (less) pronounced for firms that are more (less) likely to engage in financial misreporting before clawback adoptions. This latter finding is consistent with firms adopting clawback provisions in response to accrual-based management by CEOs, which in turn motivates CEOs to shift capital investment mix from R&D to capex to preserve performance-linked compensation. Path analyses confirm performance-based compensation as a mediating channel through which clawback adoptions influence capital investment mix and efficiency.

Corroborating tests support our findings. First, shifts in the capital investment mix from R&D to capex are likewise observed for the entire matched sample containing both R&D and non-R&D intensive firms, albeit with lower statistical significance reflecting that some firms conduct little or no R&D. Second, our results disappear when the event date is reset to two and three years before the clawback adoption year, lending credence to our identification of clawback effects on capital investment mix and efficiency. Third, R&D and capex follow parallel trends in the pre-adoption period consistent with a clawback adoption causal effect. Finally, our results remain qualitatively similar when using an entropy-balanced unmatched sample and for a subsample of firms without CEO turnover during the pre- and post-adoption periods, thus making it unlikely that CEO changes explain our results.

Our findings extend the literature in several ways. First, we identify performance-based CEO compensation incentives as a channel through which the adoption of clawback provisions influences capital investment decisions. As such, our findings complement those of Chen et al. (2015), Chen and Vann (2017), Liu et al. (2020), and Babenko et al. (2023) in revealing that R&D reductions associated with clawback provision adoptions comprise part of a capital investment mix response that includes capex increases and insignificant changes in their total.[7] Our findings also extend the results of Shalev et al. (2013) and Martin et al. (2016), which relate performance-based compensation to capital investment decisions but do not consider the effects of clawback provision adoptions that induce capital investment mix shifts to preserve performance-based compensation.[8]

Second, our findings extend research on the effects of clawback provision adoptions on capital investment efficiency. Whereas prior findings confirm that clawback provision adoptions enhance financial reporting quality (Chen and Vann, 2017; Liu et al., 2018), which in turn enhances capital investment efficiency (e.g., Biddle et al., 2009) as proponents purport, our findings reveal the unintended consequence that performance-based compensation incentives induce countervailing shifts in capital investment mix from R&D to capex that lower capital investment efficiency.

Third, our findings that performance-based compensation serves as a channel through which clawback adoptions induce R&D-to-capex shifts in capital investment mix, thereby reducing capital investment efficiency, help inform financial regulators and exchanges regarding clawback policies. In particular, we provide evidence of possible effects of newly issued SEC Rule 10D-1 as it explicitly requested (SEC, 2015, 103–104), and that now requires clawback provision adoptions as a condition for U.S. exchange listing citing this study (SEC, 2022, 152).

Section 2 discusses the related literatures and develops our hypotheses. Section 3 details the sample selection procedure and data. Sections 4, 5, and 6 describe our empirical design, results, and robustness tests, respectively, and Section 7 summarizes our findings.

2. Prior research and hypotheses

2.1. Related findings and regulations

Allegations of compensation-enhancing earnings management by prominent financially distressed firms in the early 2000s motivated the U.S. Congress to sanction restitutive clawbacks of executive compensation based on restated earnings in Section 304 of the Sarbanes–Oxley Act (U.S. House of Representatives, 2002). Company boards responded by voluntarily adopting clawback provisions to discourage accrual management and enhance financial reporting quality, which are their purported benefits. Similar allegations during the 2008–2009 financial crisis motivated Section 954 of the Dodd–Frank Act of 2010 (U.S. House of Representatives, 2010), which makes clawback provision adoptions a condition for U.S. exchange listings. SEC Rule 10D-1 to implement Dodd–Frank Act Section 954 cogently observes that while clawback adoptions "could result in higher-quality financial reporting that would benefit investors, they may also distort capital allocation decisions" (SEC, 2022, 136). Accordingly, Rule 10D-1 in draft form explicitly requested "comment on any effect the proposed requirements may have on efficiency, competition and capital formation" (SEC, 2015, 103–104). On October 26, 2022, the SEC issued Rule 10D-1 (SEC, 2022) by a split party-line vote, with amended application to current and former executive officers for restatements irrespective of misconduct, and to smaller reporting companies, emerging growth companies, and foreign private issuers previously exempted (Sisitsky et al., 2022) among other dissenting member objections (Peirce, 2022). Clawback provision adoptions will thereby be effectively mandatory for all U.S. listed firms on or before November 28, 2023.

[6] We find corroborating evidence that the likelihood of overinvesting in capex and underinvesting in R&D increases after the adoption of clawback provisions.

[7] In comparison, we employ design features focusing on the effects on the capital investment mix of clawback provision adoptions, including path analyses testing for their mediation by performance-based compensation incentives after controlling for performance volatility and risk, and allowing for more than one mediation channel to be operative.

[8] Shalev et al. (2013) propose that CEOs overstate acquisition goodwill to boost earnings-based bonuses and Martin et al. (2016) propose that stock option compensation incentivizes PP&E durability, both accruals-based earnings management. Because clawback adoptions discourage accruals-based earnings management, we propose that they motivate real earnings management capital investment mix shifts incentivized by performance-based compensation.

Research indicates across a range of paradigms that clawback adoptions enhance financial reporting quality, a purported benefit cited by proponents.[9] Related findings indicate that higher-quality financial reporting in turn reduces information asymmetry regarding future payoffs and investment project risk (e.g., Leuz and Verrecchia, 2000; Healy and Palepu, 2001) and helps to mitigate capital overinvestment and underinvestment (e.g., Biddle and Hilary, 2006; Hope and Thomas, 2008; McNichols and Stubben, 2008; Biddle et al., 2009; Chen et al., 2011; Chen et al., 2013; Cheng et al., 2013; Lo, 2015).

However, another line of research questions whether clawback provision adoptions enhance financial reporting quality. In particular, Denis (2012) argues that the reduction in earnings restatements reported by Chan et al. (2012) reflect CEOs' attempts to avoid clawback adoptions, and that observed reductions in audit effort may reflect auditors' overconfidence in the positive effects of clawback provisions on financial reporting quality. Fried and Shilon (2012) argue that clawback provisions are rarely enforced even when earnings restatements occur. Chan et al. (2015), Bao et al. (2018), Kubick et al. (2020), and Kyung et al. (2019) find a positive relationship between clawback adoptions and real earnings management that could reduce or offset financial reporting quality benefits.

Elaborating, Chan et al. (2015) present evidence that clawback provision adoptions are associated with reductions in discretionary expenses, including R&D expenses, which they attribute to managerial incentives to meet or beat earnings targets. Because R&D expenses are essentially equivalent to R&D capital investments under U.S. GAAP, their findings raise questions regarding how clawback provision adoptions influence capital investment decisions more broadly. Several subsequent studies argue that relations between clawback adoptions and capital investments relate alternatively to governance quality, risk reduction, and overinvestment mitigation (Chen and Vann, 2017; Liu et al., 2020; Babenko et al., 2023). Specifically, Chen and Vann (2017) find lower capital overinvestment and earnings volatility for firms adopting clawbacks, which they attribute to risk mitigation that is offset by *strong* board governance that motivates CEOs to be more risk-seeking.[10] In contrast, Liu et al. (2018) argue that lower capital overinvestment following clawback adoptions is offset by *weak* board governance, including for capex and non-capex investments (R&D and acquisition expenditures) for firms prone to overinvestment. Liu et al. (2020) also find lower capex expenditures following clawback adoptions that they attribute to risk reduction, but insignificant R&D expenditure changes as echoed for R&D by Babenko et al. (2023). Considered altogether, these mixed findings beg for evidence regarding how clawback adoptions influence capital investments and capital investment efficiency.

2.2. Hypotheses

Our hypotheses reflect the research findings above and the reasoning of SEC Rule 10D-1 that "while [clawback provisions] could result in high-quality financial reporting that would benefit investors, they may also alter operating decisions of executive officers" (SEC, 2015, 103–104). Specifically, our first hypothesis examines whether performance-based compensation incentives serve as a channel through which CEO responses to the adoption of clawback provisions influence capital investment mix. Our second hypothesis examines whether changes in capital investment mix incentivized by performance-based compensation offset capital investment efficiency benefits provided by the improved financial reporting quality associated with clawback adoptions.

Our first hypothesis combines two research streams related to executive compensation incentives. The first stream finds that clawback adoptions motivate CEOs to substitute real earnings management for accrual-based earnings management to preserve their performance-based compensation without restatement-triggering recoupments (e.g., Chan et al., 2015). The second stream observes that capital investments, which are subject to considerable managerial discretion, have differing earnings payback patterns that differ by capital investment component (Kothari et al., 2002; Amir et al., 2007; Canace et al., 2018).[11] In particular, R&D capital investments are expensed and thus reduce earnings immediately in exchange for generally delayed and uncertain earnings paybacks. Capex capital investments by comparison boost earnings more predictably by expanding existing business operations in exchange for formulaic amortization and depreciation charges longer run. Thus, shifting the capital investment mix from R&D to capex offers CEOs the real

[9] Chan et al. (2012) and Dehaan et al. (2013) find that clawback adoptions are associated with reductions in earnings restatements, reported material internal control weaknesses, and in audit fees and hours. Dehaan et al. (2013) find that clawback adoptions decrease the frequency with which reported earnings meet or just beat consensus analysts' earnings forecasts. Dehaan et al. (2013), Iskandar-Datta and Jia (2013), Chan et al. (2013), Chen et al. (2014), and Babenko et al. (2023) find that investors respond favorably to voluntary clawback adoptions, which is consistent with clawback adoptions representing a commitment to high-quality financial reporting. Dehaan et al. (2013), Chen et al. (2014), and Kroos et al. (2018) document an increase in the sensitivity of CEO annual pay to reported earnings for clawback adopters, which is consistent with boards perceiving post-adoption earnings as revealing of executive performance and effort, although Iskandar-Datta and Jia (2013) do not find similar results.

[10] Kim and Wei (2021) present corroborative cross-country evidence that board reform legislation considered broadly enhances capital investment efficiency by mitigating capital overinvestment.

[11] Kothari et al. (2002, 355) present evidence that is "strongly consistent with the hypothesis that R&D investments generate future benefits that are far more uncertain than benefits from investments in PP&E." Similarly, Amir et al. (2007) find that R&D contributes to subsequent earnings variability more than capex does in R&D-intensive industries.

earnings management opportunity to enhance performance-based compensation in response to the adoption of clawback provisions that discourage accrual-based earnings management.[12]

Applying this evidence and reasoning, we predict that CEOs who are more incentivized by performance-based compensation will respond to clawback provisions by reducing R&D and increasing capex capital investments to a greater degree than CEOs with a smaller proportion of performance-based compensation. We consider two performance-based compensation measures: (1) performance-based annual pay, and (2) equity incentives, both in proportion to total annual compensation.[13] Appendix A provides an example of clawback provisions for Advanced Micro Devices (AMD), which recover the excess amount of equity awards and non-equity incentive components of annual pay based on misstated financial statements. CEOs more motivated by equity incentives than performance-based pay will have incentives to preserve the values of share and stock option holdings because share prices reflect growth options, which investors will perceive. Thus, clawback adoptions that discourage accrual-based earnings management may motivate CEOs with equity holdings to use real earnings management to hide bad news regarding growth opportunities, as Benmelech et al. (2010) argue.[14] Applying their reasoning, on the adoption of a clawback provision, a CEO with equity will be motivated to reduce R&D expenditure and reallocate the unspent resource to capex to boost near-term earnings and mitigate any negative consequence for firm value. To corroborate this reasoning, we test for changes in the total investment sum of R&D and capex.[15]

As acquisition capital investments are not expensed immediately, CEOs also can consider shifting the capital investment mix from R&D to acquisition capital investments to boost short-term earnings performance and performance-based compensation in response to clawback adoptions. We also consider this empirically, recognizing that corporate acquisitions are dependent on enabling financing availability with attendant implications for self-selection and sample size.

Following from the above discussion, we first hypothesize that clawback adoptions will induce CEOs who are more motivated by performance-based compensation to alter the mix of their capital investments from R&D to capex, expressed in alternate form as:

H1. The adoption of clawback provisions motivates CEOs with higher levels of performance-based compensation to shift capital investment mix from R&D to capex.

Our second hypothesis tests whether compensation-incentivized shifts in capital investment mix associated with clawback adoptions influence capital investment efficiency. Our reasoning reflects that the capital investment efficiency effects of investment mix shifts induced by performance-based CEO compensation incentives in response to clawback adoptions (H1) could mitigate or offset beneficial effects on capital investment efficiency of improved financial reporting quality. Expressed another way, our second hypothesis reflects the Rule 10D-1 request for evidence regarding effects beyond financial reporting quality of changes in operating decisions by executive officers in response to clawback adoptions, including for efficiency. To discern these counteracting effects on capital investment efficiency, we control for financial reporting quality (i.e., accrual quality and restatement history) and test the following hypothesis conditioned on managerial compensation incentives in null form[16]:

H2. Compensation-incentivized capital investment mix shifts associated with clawback adoptions do not change capital investment efficiency.

3. Sample selection and data description

3.1. Propensity score matching and sample selection

We examine voluntary clawback adoptions for fiscal years 2005–2012 inclusive to provide comparability with prior findings and to isolate board and CEO incentives following the sanctioning of clawbacks by Section 304 of the Sarbanes–Oxley Act and until progressive adoptions of Dodd–Frank Act provisions intimated their immanent requirement for U.S. share listings.

Following the literature (e.g., Chan et al., 2012), we use the GMI Ratings database to identify firms that voluntarily adopt clawback provisions. We exclude financial firms because many are subject to clawbacks mandated by the Troubled Asset Relief Program after

[12] If clawback adoptions increase the sensitivity of annual pay to current earnings, as research indicates (e.g., Dehaan et al., 2013), this will further amplify incentives for "real" earnings management using capital investments. Despite the risk of potential future clawbacks, the increase in pay–performance sensitivity might lead to an increase in accrual manipulation but to such a degree that it will not trigger future earnings restatements. Beyond that level, managers may increase the manipulation of real transactions. In Section 5, we conduct a path analysis to show that our findings are robust to the positive effect of clawback adoptions on pay–performance sensitivity.

[13] Equity incentives are measured by the equity portfolio delta deflated by the equity portfolio delta plus cash compensation (e.g., Bergstresser and Philippon, 2006; Kim et al., 2011). These performance-based compensation measures are not mutually exclusive due to the presence of other compensation components, notably annual bonuses, non-equity incentives, accumulated equity grants, and equity sales. Empirically, the Pearson correlation between the high performance-based annual pay and high equity incentive compensation conditions is 0.187 for our sample.

[14] Benmelech et al. (2010, 1) show analytically that "stock-based compensation not only induces managers to exert costly effort, but also induces them to conceal bad news about future growth options and to choose suboptimal investment policies to support the pretense." The underlying assumption is that reporting the growth of earnings could affect investors' perceptions of growth opportunities.

[15] This real earnings management conjecture differs from an alternative conjecture that clawback adoptions will lead CEOs to reduce risk by lowering total capital investment, a condition that we also do not find empirically.

[16] In robustness tests, we also consider the risk-taking reduction explanation for R&D expenditure reductions associated with clawback adoptions proposed by Chen and Vann (2017), Liu et al. (2020), and Babenko et al. (2023).

2008. Clawback adoptions generally increased year-on-year during our sample period, rising from 19 in 2005 to 209 in 2012, with 56% (588/1032) of new clawback adoptions occurring between 2010 and 2012 inclusive. We obtain accounting data from Compustat, share price data from the Center for Research in Security Prices (CRSP), corporate governance data from RiskMetrics and GMI Ratings, analyst coverage data from Refinitiv's Institutional Brokers' Estimate System (I/B/E/S), and institutional ownership data from Thompson Financial. We merge these data with the clawback data from GMI Ratings.

We require R&D expenditures for three years immediately before clawback adoptions to focus in our main tests on firms with business models that invest in R&D on a regular basis, and are thus germane to testing for within-firm shifts in the capital investment mix from R&D to capex in response to clawback adoptions.[17] We likewise require observations for capital investment determinant variables for three years before and after clawback adoptions (inclusive) to effectively control for their effects and to allow sufficient time for CEOs to adjust capital investment mix in response to clawback provision adoptions. To mitigate the influence of extreme outliers, we winsorize each continuous variable at the 1st and 99th percentile.[18] These criteria provide a sample of 1257 firm-year observations comprised of 697 observations for 136 clawback adopters and 560 observations for 107 non-adopters. The sample selection procedure is summarized in Panel A of Table 1.

To control for differences in firm characteristics that may influence clawback adoptions and capital investment decisions, we follow Chan et al. (2012) to create a propensity score matched sample of firms that have not adopted clawback provisions but have a similar probability of adopting them. We do this by estimating a probit regression of an indicator variable for clawback adopters ($Clawback_t$) on the ex-ante economic determinants of clawback adoptions identified in prior studies (X_{t-1}):

$$Clawback_t = \alpha_0 + \sum \alpha_i X_{t-1} + \varepsilon_t \tag{1}$$

where $Clawback_t$ equals one if a firm first adopts a clawback provision in year t and zero if a firm does not adopt a clawback provision over the entire sample period (i.e., 2002 to 2012). As in Chan et al. (2012), X_{t-1} includes firm size (*LogAsset*), market-to-book ratio (*MB*), financial leverage (*Lev*), accounting profitability (*ROA*), number of business segments (*LogSegment*), financial restatements during the three years preceding clawback adoption (*Restate_prior_3y*), board independence (*Independence*), audit committee size (*Auditsize*), number of board meetings (*Boardmeeting*), institutional ownership (*Institutional*), insider ownership (*Insiderowen*), year fixed effects, and industry fixed effects (based on two-digit Standard Industry Classification (SIC) codes). Firm size and the market-to-book ratio capture investment opportunities potentially related to managerial incentives and financial reporting. Insider ownership is directly related to managerial incentives and financial reporting. Prior restatements reflect firms' incentives to restore credibility to financial reporting. Firm size and the number of business segments reflect the effects of operational complexity on the ability of external stakeholders to monitor managerial behavior. Corporate governance variables, ownership variables, and financial leverage reflect the intensity of monitoring and influence over managerial behavior. The likelihood of clawback adoptions is designed as a non-linear function of these firm characteristics that may affect a firm's financial misreporting, monitoring, and capital investment mix.[19] Appendix B provides definitions of all variables used in this paper.

Panel B of Table 1 presents probit regression results for the propensity score matching. The results indicate that the likelihood of adopting a clawback provision is positively associated with firm size, the number of business segments, and the incidence of pre-adoption restatements, and negatively associated with insider ownership. Estimating Eq. (1) yields a propensity score for each firm-year in the predicted value of clawback adoption likelihood (*Clawback*).

We match each clawback adoption firm-year with the non-adopting firm-year with the closest propensity score and within a distance of 0.01 from the adopting firm's propensity score. This matching process assigns a pseudo-adoption year to control firms even though they have not adopted clawback clauses throughout the entire sample period. Panel C of Table 1 indicates no statistically significant difference for any determinant of *Clawback* between adopters and non-adopters in the adoption year, suggesting that the propensity score matching identified control firms for clawback adopters with similar characteristics.

Panel D of Table 1 presents the sample distribution by industry. Our sample consists mainly of manufacturers (86.9%, one-digit SIC code = 2, 3) germane to shifts in capital investment mix from R&D to capex. For comparison, a matched sample including both R&D-intensive and non-R&D intensive firms contains >10% merchandisers (17.5%, one-digit SIC code = 5) and transportation and utility firms (12.6%, one-digit SIC code = 4), which is similar in industry distribution to an unmatched sample.[20]

3.2. Descriptive statistics

Table 2 presents descriptive statistics for the variables used in the capital investment regressions measuring capital investment, investment opportunities, accrual quality, corporate governance, liquidity, capital structure, and compensation incentives. The

[17] Nearly 33% of Compustat firms do not report R&D expenses as separate line items for four consecutive years.

[18] Because the capital investment variables are highly positively skewed, winsorizing at the 99th percentile level results in a loss of 36 of 1293 observations. Untabulated results based on the unwinsorized sample are qualitatively similar to those based on the winsorized sample.

[19] The test results for the parallel trend assumption (Table 8) indicate no significant differences in capital investments between clawback-adopting firms and their control firms before clawback adoptions.

[20] When we use the matched sample that includes both R&D and non-R&D intensive firms, our main results remain qualitatively similar though generally less statistically significant as would be expected for a sample that includes firms that do not exhibit continual R&D expenditures three years prior to clawback adoptions. We do not tabulate these results for brevity.

Table 1
Propensity score matching and sample.

Panel A: Summary of the sample selection procedure

	Number of observations
All Russell 3000 constituents (excluding financial firms) adopting clawback provisions between 2005 and 2012 inclusive	1032 firms
Subset matched with control firms using propensity score matching	966 firms
Merged firm-year observations with all determinants for capital investment available between 2002 and 2012, omitting observations beyond *t*-3 to *t* + 3	4200
Firm-year observations omitted for firms with no R&D expenditure before the clawback adoption year	(2680)
Firm-year observations omitted for firms without at least one R&D expenditure during the post-adoption period	(227)
Firm-year observations omitted for firms with extreme outliers of capital investment variables beyond the top one percentile of the sample	(36)
Final firm-year sample with R&D intensive firms	1257

Panel B: Logit regressions for propensity score matching

Dependent Variable = Clawback Adoption in Year *t*

Determinant	Coefficient	*p*-value	
Intercept	−3.277	< 0.0001	***
LogAsset	0.132	< 0.0001	***
Lev	−0.076	0.526	
ROA	0.010	0.949	
MB	−0.002	0.739	
LogSegment	0.086	0.004	***
Restate_prior_3y	0.145	0.008	***
Independence	0.025	0.897	
Institutional	0.058	0.208	
Boardmeeting	0.002	0.764	
Auditsize	0.019	0.383	
Insiderowen	−0.820	< 0.0001	***
Industry fixed effects	Yes		
Year fixed effects	Yes		
Observations	12,893		
Pseudo R-squared	0.083		

Panel C: T-tests for the mean differences in the determinants of clawback adoptions in the adoption year

Variable	Clawback-adopting firms (1)	Non-adopting firms (2)	Mean difference ((3) = (1)–(2))	*t*-value
LogAsset	7.877	7.748	−0.129	−0.64
Lev	0.158	0.151	−0.007	−0.34
ROA	0.051	0.049	−0.002	−0.12
MB	3.138	3.247	0.109	0.30
LogSegment	1.622	1.65	0.028	0.22
Restate_prior_3y	0.169	0.14	−0.029	−0.43
Independence	0.731	0.733	0.002	0.61
Institutional	0.729	0.662	−0.067	−0.13
Boardmeeting	8.243	7.832	−0.411	−1.04
Auditsize	3.699	3.841	0.142	1.13
Insiderowen	0.06	0.073	0.013	1.09

Panel D: The sample distribution by industry

One-digitSIC	R&D matched firms (A)		All matched firms (B)		Unmatched firms (C)		Difference (D = B – A)		Difference (E = C – A)		Difference (F = C – B)	
	N	%	N	%	N	%	N	%	N	%	N	**%**
0	0	0	0	0	34	0.3	0	0	34	0.3	34	0.3
1	34	2.7	135	5.6	851	6.4	101	2.9	817	3.7	716	0.8
2	361	28.7	461	19.1	2324	17.6	100	−9.6	1963	−11.2	1863	−1.6
3	732	58.2	793	32.9	4251	32.1	61	−25.4	3519	−26.1	3458	−0.8
4	10	0.8	305	12.6	1596	12.1	295	11.8	1586	11.3	1291	−0.6
5	8	0.6	422	17.5	1714	12.9	414	16.9	1706	12.3	1292	−4.6
7	90	7.2	207	8.58	1824	13.8	117	1.4	1734	6.6	1617	5.2

(*continued on next page*)

Table 1 (*continued*)

Panel D: The sample distribution by industry

One-digitSIC	R&D matched firms (A)		All matched firms (B)		Unmatched firms (C)		Difference (D = B – A)		Difference (E = C – A)		Difference (F = C – B)	
	N	%	N	%	N	%	N	%	N	%	N	%
8	18	1.43	86	3.56	586	4.4	68	2.1	568	3.0	500	0.9
9	4	0.32	4	0.17	63	0.5	0	−0.2	59	0.2	59	0.3
Total	1257	100	2413	100	13,243	100	1156	0	11,986	0	10,830	0.0

Note: The final sample consists of 1257 observations for 243 firms (697 observations for 136 clawback adopters and 560 observations for 107 non-adopters).

Note: All variables are defined in Appendix B. *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively, for two-sided *t*-tests.

Note: *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively, for two-sided *t*-tests.

Note: These samples contain non-financial firms and exclude observations with missing values for the variables of the regression models.

medians of *R&D* and *Capex* are 3.06% and 3.45% of lagged total assets, respectively. The median and 75th percentile of *Capex* + *R&D* are 0.35% and 2.89% of lagged total assets, respectively, indicating that our sample firms do not frequently engage in large-scale acquisitions concurrently with clawback adoptions. The 25th percentiles of institutional ownership (*Institutional*) and analyst coverage (*Analysts*) are 65% and 6, respectively, suggesting that the managerial behaviors of our sample firms are generally monitored by institutional investors and analysts. At the 25th percentile, the performance-based annual pay ratio (*PerfPayRatio*) is 72.9% and the equity incentive (*EquityIncentive*) is 10.56%, suggesting that the sample CEOs receive a significant portion of their compensation in the form of share-based or non-equity incentives.[21] Compared with *EquityIncentive* (reflecting the share and option *delta*), *RiskTolerance* (reflecting the option *vega*) is small in magnitude for our sample (75th percentile = 18.03%).

4. Research design and empirical results

4.1. Effects of clawback adoptions on next-period capital investment mix

The relationships between clawback adoptions and capital investment by type are estimated using the following regression model:

$$InvVar_{t+1} = \beta_0 + \beta_1\, Clawback_t + \beta_2\, Post_t + \beta_3\, Clawback_t \times Post_t + \sum \beta_i\, Control_t + \text{Fixed Effects} + \varepsilon_t \tag{2}$$

where $InvVar_{t+1}$ refers to the investment policy variables: (a) $Investment_{t+1}$, defined as total capital investment (measured as the sum of R&D expenditure, capex, and acquisitions minus sales of property, plant, and equipment) for year $t+1$ multiplied by 100 and scaled by total assets at the end of year *t*; (b) $R\&D_{t+1}$, defined as R&D expenditure for year $t+1$ times 100 deflated by total assets at the end of year *t*; (c) $Capex_{t+1}$, defined as one-year-ahead capital expenditure net of cash receipts from sale of property, plant, and equipment multiplied by 100 and deflated by total assets at the end of year *t*; (d) $R\&D + Capex_{t+1}$, defined as the sum of R&D and capex for year $t + 1$ multiplied by 100 deflated by total assets at the end of year *t*; and (e) $Acquisition_{t+1}$, defined as acquisitions for year $t+1$ multiplied by 100 deflated by total assets at the end of year *t*.

Coefficient β_2 on *Post* reflects the average difference in unexpected capital investments of clawback adopters compared with non-adopters between the pre- and post-adoption periods.[22] Coefficient β_3 on *Clawback* × *Post* indicates the incremental average effect of clawback adoptions on unexpected capital investment components. Coefficient β_1 on *Clawback* is implicit in firm fixed effects, whereas *Post* retains year fixed effects because firms have different adoption years.

Following Biddle and Hilary (2006) and Biddle et al. (2009), we control for the following sets of year *t* determinants of expected capital investments: (a) investment opportunities reflected in sales growth (*SalesGrowth*), Tobin's q (*Q*), and *LogAsset*; (b) financial constraints measured by operating cash flow (*CFOsale*), operating cycle (*OperatingCycle*), financial slack (*Slack*), firm- and industry-average capital structure (*K-structure* and *Ind-K-structure*, respectively), and the dividend payout ratio (*Dividend*); (c) firm risk reflected in the standard deviation of operating cash flow (*StdCFO*), the standard deviation of sales (*Std-sales*), the *Z*-score (*Z-score*), tangibility (*Tangibility*), and an indicator of operating losses (*Losses*); (d) the intensity of monitoring reflected in the corporate governance index (*g-index*), an indicator variable for missing *g-index* values (*G-Dummy*), institutional ownership (*Institutional*), and *Analysts*; (e) accrual quality (*AQ*), associated with information asymmetry between managers and external investors; (f) the firm's life cycle reflected by firm age (*Age*) and *LogAsset*; and (g) the standard deviation of total investment (*StdInvestment*).[23]

Furthermore, we control for additional determinants of expected capital investment. First, we control for the current-year capital

[21] In other words, the median of the equity delta times one standard deviation of the one-year daily share returns is equal to 19.5% of CEO total annual pay, suggesting that managers have significant equity exposure to share price changes.

[22] Because sample firms adopt clawback provisions in different fiscal years, controlling for year-fixed effects does not automatically drop the variable *Post*.

[23] Some variables control for risk-taking, as in Coles et al. (2006) and Bargeron et al. (2010), including firm size, market-to-book ratio, capital structure, standard deviations of cash flow and sales, an indicator variable for losses, and/or *Z*-score.

Table 2
Descriptive statistics for variables used in capital investment regression models.

	N	Mean	STDDEV	P25	Median	P75
Investment	1257	12.75	9.39	6.29	10.16	16.62
R&D	1257	3.83	2.94	1.79	3.06	4.88
Capex	1257	5.67	5.65	1.45	3.45	8.54
Capex + R&D	1257	3.28	7.00	0.00	0.35	2.9
Acquisition	1257	9.48	6.28	4.87	7.7	12.45
Institutional	1257	0.73	0.27	0.65	0.81	0.92
Analysts	1257	13.52	9.94	6.00	12.00	20.00
G-Score	1257	7.94	4.23	6.00	9.00	11.00
G-Dummy	1257	0.16	0.37	0.00	0.00	0.00
AQ	1257	−0.05	0.04	−0.06	−0.04	−0.03
SalesGrowth	1257	9.65	20.62	−0.14	8.30	16.90
LogAsset	1257	7.87	1.56	6.75	7.75	8.80
Q	1257	1.97	0.94	1.33	1.71	2.35
StdCFO	1257	0.04	0.03	0.02	0.03	0.05
StdSale	1257	0.12	0.09	0.06	0.09	0.15
Std-Inv	1257	8.30	11.62	2.24	4.82	8.85
Z-score	1257	−2.34	0.94	−2.97	−2.31	−1.78
Tangibility	1257	0.46	0.31	0.23	0.38	0.62
K-Structure	1257	0.13	0.14	0.02	0.10	0.20
Ind-K-Structure	1257	0.14	0.09	0.07	0.12	0.19
Slack	1257	0.19	0.17	0.05	0.13	0.28
CFOsale	1257	0.13	0.11	0.07	0.12	0.18
Dividend	1257	0.57	0.49	0.00	1.00	1.00
OperCycle	1257	4.85	0.47	4.62	4.85	5.13
Losses	1257	0.16	0.36	0.00	0.00	0.00
Age	1257	30.16	21.39	13.00	23.00	41.00
MissR&D	1257	0.01	0.09	0.00	0.00	0.00
PerfPayRatio	1257	78.28	15.54	72.89	83.13	88.50
EquityIncentive	1257	25.46	20.17	10.56	19.48	34.92
RiskTolerance	1257	12.80	11.34	4.06	9.57	18.03
Tenure	1257	7.07	6.39	3.00	5.00	9.00
Q_{IND}	1133	1.532	8.159	0.625	1.010	1.537
OCF	1133	0.181	0.117	0.113	0.159	0.231
RQ	1133	0.136	0.059	0.109	0.133	0.164

This table presents descriptive statistics for the capital investment mix and its control variables. All variables are defined in Appendix B.
Note: The variables testing for capital investment efficiency have 124 fewer observations than the main regression results because the estimation of the research quotient (*RQ*) requires at least six to eight years of R&D data.

investment mix (i.e., *R&D*, *Capex*, and *Acquisition*) because some investment projects require a mix of capex and R&D expenditure over several years. Second, an indicator variable for missing R&D expenses (*MissR&D*) is associated with past and future R&D activities (Koh and Reeb, 2015). Third, we control for *PerfPayRatio* because a CEO with a higher (lower) ratio of performance-based pay to total annual pay is more (less) likely to be concerned about how a shift in the capital investment mix will affect annual firm performance. Fourth, we control for the slope and convexity of CEO incentive portfolio payoffs, which can affect managerial decisions on the capital investment mix. Specifically, following Core and Guay (2002) and Coles et al. (2006), we measure *Vega* as the dollar change in CEO equity wealth due to a 0.01 change in share return volatility and *Delta* as the dollar change in CEO equity wealth due to a 1% change in share prices.[24] Fifth, CEOs with high equity incentives have been found to diversify firm-specific exposure by selling some of their vested equity in the near term (e.g., Cheng and Warfield, 2005;Jensen, 2005; Bergstresser and Philippon, 2006; Edmans et al., 2017). Applying this need for equity sales, managers with greater (lesser) equity incentives will be more (less) concerned about short-term stock prices and thus more motivated to manipulate earnings. Sixth, we include CEO *RiskTolerance*, defined as 100 × *Vega*/(*Vega* + *Cash Compensation*). Finally, we include CEO tenure to control for the influence of career concerns on capital investment decisions.

To mitigate bias associated with unobservable covariates, we control for firm fixed effects (e.g., the firm's business model or governance) and year fixed effects (i.e., macroeconomic conditions and regulatory changes, such as the Dodd–Frank Act of 2010). We base our statistical inferences on *t*-statistics with robust standard errors clustered by firm.

H1 predicts that CEOs with higher levels of performance-based compensation incentives are more likely to reduce R&D and increase capex following clawback adoptions than CEOs with lower levels of performance-based compensation. To test H1, we first

[24] If CEOs are risk averse and cannot diversify away their firm-specific wealth, a higher (lower) level of *Vega* will encourage them to undertake more (less) risky investment projects (Coles et al., 2006). Coles et al. (2006) find a negative association between *Vega* and capex (producing a less uncertain financial outcome than R&D) and a positive association between *Vega* and R&D expenditure (producing a more uncertain financial outcome than capex) after controlling for *Delta*. Laux (2014) considers a tradeoff between *Vega*, earnings manipulation, and capital investment efficiency. Following Bergstresser and Philippon (2006) and Kim et al. (2011), we use a normalized measure for the equity incentive, 100 × *Delta*/(*Delta* + *Cash Compensation*).

estimate Eq. (2) for subgroups partitioned by annual performance-based pay ratio and equity incentive to allow the coefficients on each variable to vary across subsamples. *HighPerfPay* is equal to one if a firm's mean ratio of CEO performance-based pay to CEO total annual pay over the pre-adoption period is higher than the sample median during the pre-adoption period, and zero otherwise. *HighEquityInc* is equal to one if a firm's mean equity incentive in the pre-adoption period is higher than the sample median for the pre-adoption period, and zero otherwise. We estimate Eq. (2) for the dependent variables *R&D*, *Capex*, and *Capex* + *R&D* to test whether the coefficient on *Clawback* × *Post* is negative and significant for *R&D*, positive and significant for *Capex*, and not significantly different from zero for *Capex* + *R&D* as would be implied by a capital investment mix shift.

Table 3 presents the results of estimating Eq. (2), relating capital investment in total and by type to clawback adoption for the combined 1257 firm-year sample of clawback adopters and non-adopters, not conditioned on CEO annual pay and equity incentives. The coefficient on *Clawback* × *Post* for *R&D* (= −0.487% of lagged total assets) is negative and significant and the coefficient on *Clawback* × *Post* for *Capex* (= 0.405% of lagged total assets) is positive and significant.[25] *Capex* + *R&D* has a non-significant coefficient on *Clawback* × *Post*, as does *Acquisition*. These results indicate that clawback adoptions have no significant effects on combined R&D and capex capital investments or on acquisitions, and that managers shift the capital investment mix by reducing R&D and increasing capex investments.

Table 4 presents estimates for Eq. (2) relating *Capex*, *R&D*, and *Capex* + *R&D* when applied to subsamples partitioned by high versus low performance-based pay ratios (Panel A) and by high versus low equity incentives (Panel B). Table 4, Panel A indicates significant reductions in R&D expenditure (equivalent to −1.094% of lagged total assets) and significant increases in capex (equivalent to 0.825% of lagged total assets) after clawback adoptions, but only for the high performance-based pay ratio subsample, as confirmed by chi-square tests. Clawback adoptions have no significant effects on *Capex* + *R&D* for either subsample. Similarly, Table 4, Panel B shows significant reductions in *R&D* (= −0.751% of lagged total assets) and significant increases in *Capex* (= 0.661% of lagged total assets) only for the high equity incentive subsample, with consistent chi-square test results. The clawback effects on *Capex* + *R&D* are not significant for both the high and low equity incentive subsamples. Considered together, these results lend support to H1 by providing evidence that clawback adoptions motivate CEOs incentivized by performance-based compensation to shift the capital investment mix from R&D to capex.

4.2. Effects of clawback adoptions on capital investment efficiency

Following the reasoning of Section 2.2, we test H2 regarding the effects of clawback adoptions on capital investment efficiency using two capital investment efficiency measures. We tabulate results based on the q sensitivity of capital investment and the research quotient following corporate finance research. We also examine a measure of capital investment efficiency following Biddle et al. (2009) that complements q sensitivity and that provides qualitatively similar findings as we detail in Section 5.3. The ratio of the market value of capital to its replacement cost (i.e., q) is a sufficient statistic for a firm's investment opportunities under perfect competition and constant returns to scale (Tobin, 1969; Hayashi, 1982). The q sensitivity of capital investment captures the degree to which capital investment is responsive to investment opportunities (Chen et al., 2007; Peters and Taylor, 2017). To illustrate, suppose that managers shift capital investment mix as an alternative means of preserving performance-based compensation, given that accrual-based earnings management can trigger restatements and clawback penalties. If this opportunistic shift in capital investment mix does not significantly alter the sum of capex and R&D investments, it will make q less diagnostic since it reflects overall investment opportunities (Ericksen and Whited, 2000). As such, an R&D-specific efficiency measure like the research quotient can complement the investment q sensitivity in measuring capital investment efficiency effects of clawback adoptions. The research quotient, which measures the ability of current R&D to predict future revenue (output) after controlling for other production function factors (Knott, 2008), has been found to associate positively with product and process innovations (e.g., Cooper et al., 2022). Thus, if clawback adoptions induce managers with performance-based pay to reduce R&D expenditures by abandoning R&D projects with positive net present values, the output elasticity of current R&D capital expenditures measured using the research quotient will decrease after clawback adoptions.[26]

To test the effects of clawback adoptions on the q sensitivity of capital investment, we estimate the following regression:

$$
\begin{aligned}
Capex + R\&D_{t+1} = {} & \gamma_0 + \gamma_1\, Clawback_t + \gamma_2\, Post_t + \gamma_3\, Clawback_t \times Post_t + \gamma_4\, Q_{IND,t} + \gamma_5\, OCF_t + \gamma_6\, Clawback_t \times Q_{IND,t} + \gamma_7\, Post_t \\
& \times Q_{IND,t} + \gamma_8\, Clawback_t \times Post_t \times Q_{IND,t} + \gamma_9\, Clawback_t \times OCF_t + \gamma_{10}\, Post_t \times OCF_t + \gamma_{11}\, Clawback_t \times Post_t \\
& \times OCF_t + \gamma_i\, Control\ variables + \text{Fixed Effects} + \varepsilon_t
\end{aligned}
\tag{3}
$$

where $Capex + R\&D_{t+1}$ is the sum of capex and R&D for year $t+1$; $Q_{IND,\,t}$ is the industry-year average of total q; OCF_t is operating cash flow, which captures firm liquidity that enables capital investments to be readily performed; and *Control variables* and *Fixed Effects* are

[25] Column (5) of Table 3 indicates that the coefficient on *Clawback* × *Post* for acquisition capital investment is positive and insignificant. It is also insignificant for subsamples examined in other tables.

[26] It is possible that clawback adoptions induce CEOs to preserve performance-based pay by retaining R&D projects with the greatest potential for short-term success. This incentive has the potential to mitigate the negative effects of clawback adoptions on the ability of R&D to generate future revenue. However, results reported in Table 5 indicate that this effect is not dominant. Section 5.3 provides corroborating evidence that clawback provision adoptions are associated with an increased likelihood of R&D falling below its expected level associated with investment opportunities.

Table 3
Effects of clawback provisions on capital investment.

	Dependent Variable =				
	(1)	(2)	(3)	(4)	(5)
VARIABLE	$Investment_{t+1}$	$R\&D_{t+1}$	$Capex_{t+1}$	$Capex + R\&D_{t+1}$	$Acquisition_{t+1}$
Post	−1.276	0.109	−0.310	−0.176	−1.148
	(−1.39)	(0.53)	(−1.36)	(−0.52)	(−1.33)
Clawback*Post	**−0.066**	**−0.487****	**0.405***	**−0.070**	**−0.033**
	(−0.07)	**(−2.00)**	**(1.94)**	**(−0.21)**	**(−0.04)**
Institutional	0.574	0.791	0.570	1.464*	−1.030
	(0.27)	(1.29)	(1.28)	(1.93)	(−0.53)
Analysts	0.079	−0.032	0.031**	−0.008	0.076
	(1.01)	(−1.59)	(2.04)	(−0.31)	(1.11)
G-Score	−0.988	0.188	−0.421**	−0.195	−0.734
	(−1.21)	(0.55)	(−1.97)	(−0.46)	(−1.10)
G-Dummy	−8.290	0.818	−2.736**	−1.532	−6.333
	(−1.00)	(0.28)	(−2.02)	(−0.45)	(−0.97)
AccrualQuality	−0.480	0.786	−0.532	0.336	−0.507
	(−0.05)	(0.37)	(−0.29)	(0.11)	(−0.05)
SalesGrowth	0.008	0.005	0.001	0.007	0.002
	(0.58)	(1.14)	(0.34)	(1.10)	(0.14)
LogAsset	−3.645**	−3.589***	−1.074***	−4.675***	0.876
	(−2.15)	(−5.44)	(−3.14)	(−6.25)	(0.55)
Q	0.490	0.272	0.772***	1.026***	−0.512
	(0.68)	(1.17)	(4.16)	(3.52)	(−0.79)
StdCFO	20.921	1.764	1.832	4.356	16.545
	(1.11)	(0.36)	(0.49)	(0.62)	(1.07)
StdSale	−10.095*	−2.811**	−1.853*	−4.683***	−5.499
	(−1.87)	(−2.21)	(−1.88)	(−2.68)	(−1.17)
StdInvestment	−0.100	0.011	0.015	0.027*	−0.125**
	(−1.64)	(0.94)	(1.54)	(1.66)	(−2.29)
Z-Score	−2.375***	−0.241	−0.125	−0.344	−2.071***
	(−3.21)	(−0.86)	(−0.67)	(−0.95)	(−3.12)
Tangibility	8.245**	2.987	−1.532	1.581	7.065**
	(2.24)	(1.65)	(−1.29)	(0.73)	(2.19)
K-structure	−8.139*	−0.866	−3.042**	−3.842**	−4.348
	(−1.90)	(−0.75)	(−2.31)	(−1.99)	(−1.10)
Ind-K-Structure	3.853	0.855	−0.420	0.453	3.453
	(0.80)	(0.74)	(−0.31)	(0.24)	(0.81)
Slack	14.274**	−0.840	−0.197	−0.908	15.760***
	(2.44)	(−0.60)	(−0.22)	(−0.56)	(3.00)
CFOsale	5.165	1.214	1.121	2.200	2.909
	(1.10)	(0.90)	(1.16)	(1.38)	(0.70)
Dividend	1.022	0.057	−0.092	−0.003	1.041
	(0.98)	(0.16)	(−0.30)	(−0.01)	(1.22)
OperatingCycle	4.139***	2.471***	0.823**	3.177***	0.941
	(2.80)	(2.76)	(2.09)	(2.98)	(0.83)
Losses	−0.001	0.269	−0.068	0.108	−0.167
	(−0.00)	(1.09)	(−0.36)	(0.31)	(−0.23)
Age	−0.815	0.032	0.575*	0.663	−1.445
	(−0.60)	(0.10)	(1.72)	(1.33)	(−1.24)
Lagged Capex	0.221*	−0.019	0.249***	0.237***	−0.016
	(1.68)	(−0.38)	(5.50)	(3.59)	(−0.15)
Lagged R&D	0.070	0.109***	0.024	0.136***	−0.062
	(0.73)	(2.69)	(1.34)	(2.74)	(−0.88)
Lagged AQC	−0.191***	−0.025**	−0.007	−0.031**	−0.157***
	(−4.58)	(−2.41)	(−0.86)	(−2.36)	(−4.13)
MissR&D	−7.782***	−3.334*	−1.516	−4.726*	−3.320**
	(−3.05)	(−1.69)	(−1.11)	(−1.80)	(−2.29)
PerfPayRatio	0.022	0.001	0.001	0.001	0.020
	(0.89)	(0.15)	(0.31)	(0.10)	(0.86)
EquityIncent	0.057*	−0.002	−0.011*	−0.013	0.067**
	(1.74)	(−0.27)	(−1.82)	(−1.23)	(2.21)
RiskTolerance	−0.065*	−0.002	0.017**	0.015	−0.079**
	(−1.71)	(−0.19)	(2.22)	(1.03)	(−2.40)
CEO tenure	−0.078	0.014	0.021	0.036	−0.113
	(−0.86)	(0.77)	(0.80)	(0.90)	(−1.53)
Constant	33.64	15.86	−4.859	9.934	23.683
	(0.84)	(1.52)	(−0.55)	(0.70)	(0.66)
Observations	1257	1257	1257	1257	1257

(*continued on next page*)

Table 3 (*continued*)

VARIABLE	Dependent Variable = (1) *Investment*$_{t+1}$	(2) *R&D*$_{t+1}$	(3) *Capex*$_{t+1}$	(4) *Capex* + *R&D*$_{t+1}$	(5) *Acquisition*$_{t+1}$
Adjusted R-squared	0.168	0.354	0.285	0.344	0.108
Firm fixed effects	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES
Standard errors clustered by firm	YES	YES	YES	YES	YES

This table shows the results using an ordinary least squares (OLS) regression for Eq. (4) with the firm and year fixed effects and firm cluster effects. The firm fixed effects regressions using the STATA package automatically drop the coefficient on the indicator variable *Clawback*. The coefficients on *Post* reflect the average time path of the dependent variables in the absence of the treatment (i.e., the adoption of clawback provisions). See Appendix B for variable definitions. The *t*-statistics based on robust standard errors clustered by firms are reported in parentheses. *, **, and *** represent significance at the 10%, 5%, and 1% levels respectively, in a two-tailed test.

Table 4

Differences in clawback effects on capital investment with pre-adoption performance-based compensation incentives.

Panel A: High versus low CEO performance-based pay ratios before clawback adoption

	Dependent Variable =					
	R&D$_{t+1}$		*Capex*$_{t+1}$		*Capex* + *R&D*$_{t+1}$	
VARIABLE	HighPerfPay (1)	LowPerfPay (2)	HighPerfPay (3)	LowPerfPay (4)	HighPerfPay (5)	LowPerfPay (6)
Post	0.717**	−0.231	−0.625	−0.073	0.092	−0.231
	(2.17)	(−0.87)	(−1.42)	(−0.26)	(0.15)	(−0.53)
Clawback*Post	**−1.094*****	**−0.126**	**0.825****	**−0.003**	**−0.266**	**−0.109**
	(−3.19)	**(−0.42)**	**(2.22)**	**(−0.01)**	**(−0.49)**	**(−0.23)**
Control variables	Included	Included	Included	Included	Included	Included
Observations	587	670	587	670	587	670
Adjusted R-squared	0.413	0.434	0.326	0.283	0.371	0.375
Firm fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Standard errors clustered by firm	YES	YES	YES	YES	YES	YES
High versus Low PerfPay						
Difference in *Clawback*Post*	**−0.968****		**0.828***		**−0.161**	
(*p*-value)	**(0.028)**		**(0.067)**		**(0.818)**	

Panel B: High versus low CEO equity incentives before clawback adoption

	Dependent Variable =					
	R&D$_{t+1}$		*Capex*$_{t+1}$		*Capex* + *R&D*$_{t+1}$	
VARIABLE	HighEquity (1)	LowEquity (2)	HighEquity (3)	LowEquity (4)	HighEquity (5)	LowEquity (6)
Post	0.305	−0.382	−0.496	−0.194	−0.190	−0.527
	(1.10)	(−1.48)	(−1.51)	(−0.74)	(−0.39)	(−1.28)
Clawback*Post	**−0.751****	**0.240**	**0.661****	**0.061**	**−0.093**	**0.341**
	(−2.32)	**(0.86)**	**(2.17)**	**(0.23)**	**(−0.20)**	**(0.82)**
Control variables	Included	Included	Included	Included	Included	Included
Observations	684	573	684	573	684	573
Adjusted R-squared	0.435	0.481	0.278	0.326	0.387	0.394
Firm fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Standard errors clustered by firm	YES	YES	YES	YES	YES	YES
High versus Low Equity Incentives						
Difference in *Clawback*Post*	**−0.991****		**0.600**		**−0.434**	
(*p*-value)	**(0.016)**		**(0.128)**		**(0.470)**	

This table shows the results from using an OLS regression for Eq. (4) with firm and year fixed effects and firm cluster effects. The firm fixed effects regressions using the STATA package automatically drop the coefficient on the indicator variable *Clawback*. The results for *Investment*$_{t+1}$ and *Acquistion*$_{t+1}$ are not significant and omitted for the sake of brevity. See Appendix B for variable definitions. The *t*-statistics based on robust standard errors clustered by firms are reported in parentheses. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively, in a two-tailed test. The tests for differences in the coefficients on *Clawback*Post* for high versus low performance-based pay (Panel A) and high versus low equity incentives (Panel B) are based on chi-square tests.

the same as those in Eq. (2). Total q accounts for tangible and intangible capital (Peters and Taylor, 2017). We use the industry-year average of total q (based on three-digit SIC codes) to capture common information about investment opportunities in a given industry-year and mitigate the influence of firm-specific accounting distortions on firm-level market-to-book ratios. If the shift in the capital investment mix from R&D to capex reduces a firm's capital investment efficiency, then the coefficient on $Clawback_t \times Post_t \times Q_{IND,\,t}$ will be negative.

We estimate the following regression to examine how clawback adoptions influence R&D expenditure productivity:

$$RQ_{t+1} = \delta_0 + \delta_1\ Clawback_t + \delta_2\ Post_t + \delta_3\ Clawback_t \times Post_t + \sum \delta_i\ Control\ variables + \text{Fixed Effects} + \varepsilon_t \tag{4}$$

where RQ_{t+1} refers to the research quotient for year $t+1$ and a negative coefficient on $Clawback_t \times Post_t$ indicates a negative clawback effect on research quotient.[27]

In Table 5, Panel A presents the results of estimating Eq. (3) for the total sample (Column (1)) and for subsamples partitioned by CEO performance-based pay ratio (Columns (2) and (3)). In Column (1), the coefficient on $Q_{IND} \times Clawback \times Post$ is negative and significant, indicating that the q sensitivity of clawback-adopting firms declines following clawback adoptions. In Columns (2) and (3), the coefficient on $Q_{IND} \times Clawback \times Post$ is negative and significant only for the high performance-based pay subsample, as confirmed by the results of chi-square tests for differences in coefficients on $Q_{IND} \times Clawback \times Post$ between the two subgroups with high versus low performance-based pay ratios. In contrast, the coefficients in Columns (4) and (5) are negative and significant for both the high and low equity incentive subsamples for one-tailed tests (t-values $= -1.61$ and $-\ 1.88$, respectively). The chi-square test results for the differences in coefficients on $Q_{IND} \times Clawback \times Post$ between the two subgroups with high versus low equity incentives are not significant. Overall, the results in Panel A support negative effects on investment q sensitivity of clawback-adopting firms, especially for those with high performance-based annual pay ratios.

Panel B of Table 5 presents results from estimating Eq. (4), likewise showing negative effects of clawback adoptions on the research quotient only for the high performance-based annual pay ratio and the high equity incentive subsamples. Similar to the results in Panel A, chi-square test results indicate statistically significant differences in coefficients on *Clawback*Post* between the high versus low performance-based pay subsamples, but not between the high versus low equity incentive subsamples.[28] Overall, the results in Table 5 lend support to a negative association between clawback adoptions and capital investment efficiency in capex and R&D via a managerial compensation incentive channel, consistent with H2.

5. Additional tests

5.1. Path analysis of clawback adoption effects mediated by performance-based compensation

Denis (2012) argues that by increasing the risks of incentive-based compensation, clawback provisions induce firms to reduce the use of performance-based compensation for incentive alignment. In contrast, Dehaan et al. (2013) argue that by reducing financial misreporting, clawback adoptions induce firms to increase the use of incentive-based compensation. By these arguments, changes in performance-based compensation following clawback adoptions could alter capital investment mix responses in either direction. To address these arguments and provide evidence regarding compensation incentives as a channel by which clawback adoptions influence capital investment decisions, we conduct a path analysis of the direct and indirect effects of clawback adoptions on capital investment mix, as mediated by performance-based compensation.[29]

Applying this reasoning, we use the generalized simultaneous equation method to simultaneously estimate the effects of clawback adoptions on performance-based compensation measures and the impact of performance-based compensation measures on capital investment:

$$IncentiveVar_{t+1} = \delta_1\ Post_t + \delta_2\ Clawback_t \times Post_t + \sum \delta_i\ Controls_{INC,t+1} + \text{FE} + \varepsilon_t \tag{5}$$

$$InvVar_{t+1} = \beta_1\ Post_t + \beta_2\ Clawback_t \times Post_t + \beta_3\ IncentiveVar_{t+1} + \sum \beta_i\ Controls_t + \text{FE} + \varepsilon_t \tag{6}$$

where $IncentiveVar_{t+1}$ refers to the compensation incentive variables: (a) $PerfPayRatio_{t+1}$, (b) $EquityIncentive_{t+1}$, and (c) $RiskTolerance_{t+1}$. Following Core et al. (1999) and Harford and Li (2007), the covariates in Eq. (5), $Controls_{INC}$, include the 12-month market-adjusted share returns (RET_{t+1}) and sales growth ($SALECHG_{t+1}$) as other performance measures, the standard deviations of ROA and RET estimated over the previous five years ($VOLROA_{t+1}$ and $VOLRET_{t+1}$), growth opportunities proxied by the average market-to-book equity ratio (Q_{t+1}), the demand for incremental effort and the ability required to manage a large firm measured by the

[27] The sample in Table 5 has 124 fewer observations than Tables 3 and 4 because estimating firm-level research quotients requires at least six years of R&D data.

[28] Panel B of Table 5, in contrast with Panel A, presents the results of the industry fixed effects regressions. These results are qualitatively robust to replacing industry fixed effects with firm fixed effects. In Column (4) of untabulated Panel B (i.e., the high equity incentive partition), the coefficient on *Clawback*Post* is -0.009 and significant using one-tailed tests (t-value $= -1.55$, p-value $= 0.123$).

[29] Jollineau and Bowen (2023) provide a practical guide to path analysis. Applying their nomenclature, observable phenomena can be modeled with direct paths (X ➔ Y) and indirect paths (e.g., X ➔ M ➔ Y, where M is a mediator), and where a moderated mediation relationship between X and Y varies in strength or sign with a moderator variable W (i.e., a conditional analysis).

Table 5
Effects of clawback provisions on capital investment efficiency.

Panel A: Effects on the investment q sensitivity conditional on operating cash flow before R&D

	Dependent variables = $Capex + RQ_{t+1}$				
	(1)	(2)	(3)	(4)	(5)
VARIABLE		HighPerfPay	LowPerfPay	HighEquityInc	LowEquityInc
Post	−1.712**	−3.119***	−0.214	−1.688*	−1.879**
	(−2.52)	(−2.73)	(−0.27)	(−1.70)	(−2.29)
*Clawback*Post*	1.933***	3.186**	0.548	1.053	2.614***
	(2.70)	(2.39)	(0.65)	(0.87)	(2.87)
Q_{IND}	−0.864***	−0.567	−1.041**	−0.490	−0.956***
	(−2.92)	(−1.39)	(−2.48)	(−0.95)	(−2.66)
Q_{IND} **Clawback*	0.971***	0.327	1.150**	0.426	1.103***
	(3.06)	(0.67)	(2.60)	(0.79)	(2.82)
Q_{IND} **Post*	1.007**	2.256***	0.194	1.288*	0.916*
	(2.31)	(4.46)	(0.51)	(1.83)	(1.66)
Q_{IND}Clawback*Post***	**−1.113****	**−2.009*****	**−0.302**	**−1.221**	**−1.068***
	(−2.46)	**(−3.26)**	**(−0.72)**	**(−1.61)**	**(−1.88)**
OCF	−0.105	2.686	3.330	−1.466	−0.765
	(−0.03)	(0.35)	(0.95)	(−0.36)	(−0.13)
*OCF*Clawback*	4.120	9.521**	1.401	5.387	3.464
	(1.25)	(2.52)	(0.31)	(1.45)	(0.80)
*OCF*Post*	1.042	2.488	−2.939	−0.723	2.979
	(0.42)	(0.86)	(−0.76)	(−0.24)	(0.88)
OCF*Clawback*Post	**−2.823**	**−4.831**	**0.324**	**1.976**	**−7.488***
	(−0.87)	**(−1.14)**	**(0.07)**	**(0.48)**	**(−1.86)**
High versus Low Equity Incentives					
Difference in Q_{IND}Clawback*Post***		**−1.707****		**−0.153**	
(*p*-value)		**(0.017)**		**(0.866)**	
Control variables	YES	YES	YES	YES	YES
Observations	1133	535	598	615	518
Adjusted R-squared	0.396	0.417	0.424	0.375	0.464
Firm fixed effects	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES
Standard errors clustered by firm	YES	YES	YES	YES	YES

Panel B: Effects on the research quotient (RQ)

	Dependent variables = RQ_{t+1}				
	(1)	(2)	(3)	(4)	(5)
VARIABLE		HighPerfPay	LowPerfPay	HighEquityInc	LowEquityInc
Clawback	0.004	0.011	−0.004	0.009	0.003
	(0.51)	(0.88)	(−0.43)	(0.98)	(0.31)
Post	0.001	0.020*	−0.006	0.004	−0.000
	(0.14)	(1.94)	(−0.74)	(0.42)	(−0.02)
Clawback*Post	**−0.009**	**−0.023****	**0.002**	**−0.016***	**−0.009**
	(−1.37)	**(−2.50)**	**(0.29)**	**(−1.90)**	**(−1.07)**
High versus Low Equity Incentives					
Difference in *Clawback*Post*		**−0.025****		**−0.007**	
(*p*-value)		**(0.029)**		**(0.547)**	
Control variables	YES	YES	YES	YES	YES
Observations	1133	535	598	615	518
Adjusted R-squared	0.272	0.274	0.392	0.304	0.481
Industry fixed effects	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES
Standard errors clustered by firm	YES	YES	YES	YES	YES

This table shows the effects of clawback provisions on capital investment efficiency. Panel A presents the effects of clawback provisions on the sensitivity of capex + R&D to a proxy for Tobin's q that accounts for industry-level investment opportunities (Q_{IND}). Panel B presents the effects of clawback provisions on the research quotient (*RQ*). After merging the research quotient data with our capital investment data, we lose 124 observations because the estimation of *RQ* requires at least six to eight years of R&D data. In Columns (2) and (4), the variable *MissR&D* is not estimated because there are non-missing R&D values for these subsamples. See Appendix B for variable definitions. The *t*-statistics are based on robust standard errors clustered by firms. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, in a two-tailed test.

logarithm of sales in year $t+1$ ($LOGSALE_{t+1}$). We also include CEO tenure ($TENURE_t$) to control for variations in annual pay due to the CEOs' ability or entrenchment associated with tenure, and the lagged incentive variable ($IncentiveVar_{t-1}$) to control for the linear association between capital investment and incentive. We control for firm and year fixed effects and estimate *t*-values based on firm-clustered standard errors. The direct effect is the coefficient on $Clawback_t \times Post_t$ (β_2) in Eq. (6). The indirect effect mediated through performance-based compensation is the product of the coefficient on $Clawback_t \times Post_t$ (δ_2) in Eq. (5) and the coefficient on $IncentiveVar_{t+1}$ (β_3) in Eq. (6). The total effects are the sum of the direct and indirect effects.

Table 6 reports the results of estimating Eqs. (5) and (6). Panel A indicates that clawback adoptions have positive effects on *PerfPayRatio* and *EquityIncentive* (contrasting with the prediction of Denis (2012)) but a non-significant effect on *RiskTolerance*. Panel B presents the positive (negative) direct effects on *Capex* (*R&D*), the non-significant indirect effects on *Capex* and *R&D* mediated by performance-based compensation, and the positive (negative) total effects on *Capex* (*R&D*). Panel C indicates that the results presented in Panel B are more (less) prominent for firms with CEOs who receive a higher (lower) level of performance-based compensation (measured by the performance-based pay ratio and equity incentives) before clawback adoptions.[30] Overall, the results in Table 6 lend further support to H1 by indicating that performance-based compensation constitutes a mediating channel through which the adoption of clawback provisions influences shifts in the capital investment mix.

5.2. *Effects of clawback adoptions on shifts in the capital investment mix for firms more (or less) prone to engage in financial misreporting*

Our findings using a split-sample design based on the level of performance-based compensation suggest that clawback adoptions induce CEOs to use the R&D-to-capex capital investment mix as a real earnings management technique to preserve performance-based compensation. In this section, we provide corroborative evidence that shifts in the capital investment mix are more (less) pronounced for firms that are (are not) prone to engage in financial misreporting before clawback adoptions.

We begin by constructing the composite index of the likelihood of financial misreporting. Proxies for financial misreporting include (1) discretionary accruals (Dechow et al., 1995); (2) real activities manipulation (Roychowdhury, 2006)[31]; (3) the F-score (Dechow et al., 2011); (4) Accounting and Auditing Enforcement Releases (AAERs); (5) financial restatements due to non-clerical errors; and (6) material weaknesses in internal control over financial reporting. Principal component analysis is used to aggregate financial misreporting conveyed by individual proxies and helps mitigate the concern that measurement errors in individual proxies may confound the test results. Panel A of Table 7 confirms that all of these proxies have positive standardized scoring coefficients.

We assess whether shifts in the capital investment mix from R&D to capex after clawback adoptions are more (less) prominent for firms that are more (less) likely to engage in financial misreporting. To do so, we classify firms as having a high (low) likelihood of financial misreporting if their mean score of financial misreporting is higher than (less than or equal to) the sample median before the firm's (pseudo) year of adopting clawback provisions. Next, we estimate Eq. (3). According to the results reported in Panel B of Table 7, R&D decreases and capex increases after clawback adoptions by firms that are more likely to engage in financial misreporting beforehand (Columns (1) and (3)), whereas this is not the case for firms that are less likely to engage in financial misreporting before clawback adoptions (Columns (2) and (4)). Columns (5) and (6) show non-significant changes in *Capex* + *R&D* after clawback adoptions, as confirmed by untabulated chi-square tests. These results are consistent with company boards voluntarily adopting clawback provisions when managers are prone to accrual management and with managers substituting real for accrual earnings management in response.

5.3. *Relationship between clawback adoptions and capital investment efficiency*

We augment our results above based on q sensitivity using a second measure of capital investment efficiency following Biddle et al. (2009) that assesses the degree of over- or under-investment relative to an expected level associated with investment opportunities. It thus provides for directional tests of whether capital investment mix shifts from R&D to capex increase the likelihood of underinvesting (overinvesting) in R&D (capex) in testing H2.

We begin by estimating unexpected capital investment as the residual of the following regression for all Compustat non-financial firms with available data for our entire sample period:

$$InvVar_{t+1} = \gamma_0 + \gamma_1\, SalesGrowth_t + \gamma_2\, Tobin's\, Q_t + \gamma_3\, Cash_t + \gamma_4\, Lev_t + \text{Fixed Effects} + \varepsilon_t \tag{7}$$

$InvVar_{t+1}$ refers to investment policy variables (i.e., R&D and capex) for year $t+1$. $SalesGrowth_t$ and $Tobin's\ Q_t$ (measured as the ratio of the market value of total assets to the book value of total assets) are proxies for firm-level investment opportunities for year t. $Cash_t$ and Lev_t are measured as the ratio of cash balances to total assets and the ratio of total debt to total assets, respectively. They capture firm liquidity, which enables firms to readily undertake capital investments. *Fixed Effects* represent variations in capital investment associated with changes in investment opportunities and liquidity due to changes in the industry environment and structure (captured by loadings on industry-year indicator variables). Then, we estimate the residual of each regression and generate its quintiles. The indicator variable for overinvestment, $Overinvesting_{t+1}$, equals one if the residual is in the upper 20th percentile, and zero otherwise. Similarly, the indicator variable for underinvesting, $Underinvesting_{t+1}$, equals one if the residual is in the lower 20th

[30] In Panel B, the direct and total effects on *Capex* are significant in two-tailed tests only when the performance-based pay ratio is used as a mediator, whereas in Panel C, they are significant in two-tailed tests when the performance-based pay ratio and equity incentives are used as mediators.

[31] Roychowdhury (2006) measures real activities manipulation as the sum of abnormal operating cash flow, overproduction (e.g., the reduction in the cost of goods sold per unit), and the negative of abnormal discretionary expenditure (e.g., cutting R&D expenses, advertising expenses, and selling, general, and administrative expenses).

Table 6
Effects of the path analysis of direct effects and indirect effects mediated by performance-based compensation measures.

Panel A: Effects of clawback adoptions on performance-based compensation measures

	Dependent Variable =		
	PerfPayRatio$_{t+1}$	*EquityIncent* $_{t+1}$	*RiskTolerance* $_{t+1}$
VARIABLE	(1)	(2)	(3)
POST	−0.766	−2.232	−1.034
	(−0.60)	(−1.45)	(−1.16)
Clawback*POST	**3.173****	**3.408****	**1.314**
	(2.61)	**(2.08)**	**(1.33)**
PerfPayRatio	−0.043	0.036	0.018
	(−1.07)	(1.29)	(0.66)
EquityIncent	0.031	0.067*	0.012
	(0.65)	(1.65)	(0.42)
RiskTolerance	−0.150**	−0.031	0.124**
	(−2.12)	(−0.44)	(2.41)
ROA	0.192**	−0.012	−0.016
	(2.19)	(−0.27)	(−0.62)
RET	2.487*	2.416***	0.424
	(1.94)	(2.69)	(0.74)
ROAVOL	−3.740	−10.740	−1.039
	(−0.35)	(−1.30)	(−0.18)
RETVOL	−0.998	36.224*	33.205***
	(−0.05)	(1.92)	(3.23)
SALECHG	0.067**	0.023	−0.022**
	(2.39)	(1.26)	(−2.15)
Q	−0.604	0.213	0.555
	(−0.70)	(0.28)	(1.04)
LogSale	2.034	−0.779	2.390*
	(0.98)	(−0.33)	(1.70)
TENURE	0.094	0.027	−0.064
	(0.65)	(0.30)	(−0.93)
Constant	66.341***	24.568	−18.422*
	(3.90)	(1.23)	(−1.71)
Observations	1232	1232	1232
R-squared	0.090	0.143	0.105
Firm fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Standard errors clustered by firm	Yes	Yes	Yes

Panel B: Results of the path analysis of direct and indirect effects on R&D and capex investments

	Direct effects			Indirect effects mediated by performance-based compensation			Total effects		
VARIABLE	(1)	(2)	(3)	(4)	(5)	(6)	(7) = (1) + (4)	(8) = (2) + (5)	(9) = (3) + (6)
Effects on *R&D*									
Post$_t$	0.087	0.209	0.211						
	(0.43)	(1.02)	(1.04)						
***Clawback*$_t$*Post*$_t$**	**−0.499****	**−0.581****	**−0.596****	**−0.027**	**0.003**	**0.030**	**−0.527****	**−0.578****	**−0.574****
	(−2.09)	**(−2.42)**	**(−2.51)**	**(−1.46)**	**(0.18)**	**(1.21)**	**(−2.20)**	**(−2.41)**	**(−2.41)**
PerfPayRatio$_{t+1}$	−0.009*								
	(−1.67)								
EquityIncentive$_{t+1}$		0.001							
		(0.18)							
RiskTolerarence$_{t+1}$			0.019**						
			(2.35)						
Effects on *Capex*									
Post$_t$	−0.325	−0.275	−0.273						
	(−1.44)	(−1.18)	(−1.16)						
***Clawback*$_t$*Post*$_t$**	**0.391***	**0.348***	**0.355***	**0.023**	**0.013**	**0.014**	**0.414****	**0.362***	**0.369***
	(1.87)	**(1.65)**	**(1.65)**	**(1.24)**	**(0.58)**	**(0.87)**	**(1.99)**	**(1.68)**	**(1.71)**
PerfPayRatio$_{t+1}$	0.007								
	(1.45)								
EquityIncentive$_{t+1}$		0.004							
		(0.67)							
RiskTolerarence$_{t+1}$			0.010						

(*continued on next page*)

Table 6 (*continued*)

Panel B: Results of the path analysis of direct and indirect effects on R&D and capex investments

	Direct effects			Indirect effects mediated by performance-based compensation			Total effects		
VARIABLE	(1)	(2)	(3)	(4)	(5)	(6)	(7) = (1) + (4)	(8) = (2) + (5)	(9) = (3) + (6)
			(1.37)						
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1232	1198	1199	1232	1198	1199	1232	1198	1199
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard errors clustered by firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel C: Cross-sectional variations in the direct and indirect effects by the level of pre-adoption performance-based compensation incentives

	VARIABLE	Direct effects (1)	Indirect effects (2)	Total effects (3)
Firms with high performance-based pay ratios				
Mediator = *Perfpayratio*$_{t+1}$	*Effects on Capex*	0.829**	0.049	0.848**
(N = 567)		(2.18)	(0.93)	(2.35)
	Effects on R&D	−1.203***	0.008	−1.195***
		(−3.52)	(0.36)	(−3.48)
Mediator = *EquityIncentive*$_{t+1}$	*Effects on Capex*	0.829**	−0.004	0.825**
(N = 559)		(2.18)	(−0.18)	(2.13)
	Effects on R&D	−0.581**	0.003	−0.578**
		(−2.42)	(0.18)	(−2.41)
Firms with low performance-based pay ratios				
Mediator = *Perfpayratio*$_{t+1}$	*Effects on Capex*	0.005	0.044	0.049
(N = 652)		(0.02)	(1.44)	(0.17)
	Effects on R&D	−0.112	−0.024	−0.137
		(−0.39)	(−0.71)	(−0.49)
Mediator = *EquityIncentive*$_{t+1}$	*Effects on Capex*	0.005	0.010	−0.199
(N = 631)		(0.02)	(0.38)	(−0.70)
	Effects on R&D	−0.271	−0.006	−0.277
		(−1.03)	(−0.47)	(−1.06)
Firms with high equity incentives				
Mediator = *Perfpayratio*$_{t+1}$	*Effects on Capex*	0.598**	0.042	0.640**
(N = 675)		(1.99)	(1.11)	(2.16)
	Effects on R&D	−0.844***	0.016	−0.828***
		(−2.71)	(0.78)	(−2.67)
Mediator = *EquityIncentive*$_{t+1}$	*Effects on Capex*	0.595**	−0.012	0.583*
(N = 660)		(1.97)	(−0.69)	(1.92)
	Effects on R&D	−0.825***	0.003	−0.822***
		(−2.61)	(0.23)	(−2.61)
Firms with low equity incentives				
Mediator = *Perfpayratio*$_{t+1}$	*Effects on Capex*	0.077	0.021	0.098
(N = 557)		(0.29)	(0.78)	(0.36)
	Effects on R&D	0.260	−0.032	0.228
		(0.95)	(−1.28)	(0.85)
Mediator = *EquityIncentive*$_{t+1}$	*Effects on Capex*	−0.142	0.075	−0.067
(N = 538)		(−0.52)	(1.43)	(−0.24)
	Effects on R&D	0.236	−0.049	0.187
		(0.89)	(−0.99)	(0.74)
	Control variables	Yes	Yes	Yes
	Firm fixed effects	Yes	Yes	Yes
	Year fixed effects	Yes	Yes	Yes
	Standard errors clustered by firm	Yes	Yes	Yes

This table presents a path analysis based on the generalized simultaneous equation method in STATA. Panel A presents the effects of clawback adoptions on performance-based compensation measures. Panel B shows the direct and indirect effects on capex and R&D mediated by CEO performance-based compensation. The tabulation of the results of the generalized simultaneous equation method shows only the focal variables for brevity. The z-values are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, in a two-tailed test.

Table 7
Effects of clawback provisions on shifts in the capital investment mix for firms that are more or less likely to engage in financial misreporting.

Panel A: The standardized scoring coefficients on the factors or proxies for financial misreporting

Factors or proxies for financial misreporting	Standard scoring coefficients
[1] Discretionary accruals	0.0585
[2] Real activities manipulation	0.0258
[3] F-Score	0.1448
[4] AAER	0.5606
[5] Non-clerical restatement	0.5971
[6] Total internal control weaknesses	0.2847

Panel B: Effects of clawback provisions on shifts in the capital investment mix conditional on the likelihood of financial misreporting

	Dependent variable =					
	(1)	(2)	(3)	(4)	(5)	(6)
	$R\&D_{t+1}$	$R\&D_{t+1}$	$Capex_{t+1}$	$Capex_{t+1}$	$Capex + R\&D_{t+1}$	$Capex + R\&D_{t+1}$
VARIABLE	HighEM	LowEM	HighEM	LowEM	HighEM	LowEM
Post	0.130	−0.093	−0.372	−0.145	−0.260	−0.161
	(0.61)	(−0.23)	(−1.28)	(−0.40)	(−0.70)	(−0.28)
Clawback*Post	**−0.513****	**−0.282**	**0.508***	**0.116**	**0.003**	**−0.125**
	(−2.26)	**(−0.64)**	**(1.94)**	**(0.32)**	**(0.01)**	**(−0.21)**
Control variables	Included	Included	Included	Included	Included	Included
Observations	757	500	757	500	757	500
Adjusted R-squared	0.456	0.383	0.256	0.360	0.374	0.394
Firm fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Standard errors clustered by firm	Yes	Yes	Yes	Yes	Yes	Yes

This table shows the effects of clawback provisions on shifts in the capital investment mix for firms that are more or less likely to engage in financial misreporting. We construct the composite index of the likelihood of financial misreporting based on the principal component analysis of six proxies for financial misreporting. *HighEM* (*LowEM*) is equal to one for firms with a high (low) likelihood of earnings manipulation. See Appendix B for variable definitions. The *t*-statistics based on robust standard errors clustered by firms are reported in parentheses. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively, in a two-tailed test.

percentile, and zero otherwise.[32]

Next, we assess the effects of clawback adoptions on capital investment efficiency by estimating the following linear probability regression over the full matched sample and subgroups of firms partitioned by performance-based annual pay ratio and equity incentive, respectively:

$$OverandUnderinvesting_{t+1} = \delta_0 + \delta_1 \times Clawback_t + \delta_2 \times Post_t + \delta_3 \times Clawback_t \times Post_t + \sum \delta_i \times \mathrm{Controls}_t + \mathrm{Fixed\ Effects} + \varepsilon_t \tag{8}$$

This linear probability model is estimated using least squares and controls for firm and year fixed effects, firm cluster effects, and the same control variables as in Eq. (2). The coefficient on *Clawback* × *Post*, δ_3, reflects an average incremental change in the probability of overinvesting (or underinvesting) associated with the adoption of clawback provisions. The linear probability model enables us to examine within-firm variations before and after clawback adoptions and directly compare its results with those from estimating Eq. (2).

We then test H2 that shifts in the capital investment mix motivated by performance-based compensation do not influence capital investment efficiency. Panel A of Table 8 presents estimates using the linear probability model (i.e., Eq. (8)) to examine whether the shift in capital investment mix increases the probability of overinvesting or underinvesting in *R&D*, *Capex*, and *R&D* + *Capex*.[33] The coefficient on *Clawback* × *Post* is positive and significant only for Column (2) (i.e., the incidence of underinvestment in R&D, *UnderR&D*), indicating that clawback-adopting firms tend to underinvest in R&D following clawback adoptions. Panels B and C of

[32] We assume that a high (low) level of unexpected investment far exceeding (far below) a normal level of investment that is explained by firm-level investment opportunities, enabling liquidity, and changes in industry environment and structure represents over(under)investment.

[33] The results for overinvestment and underinvestment in total investment and acquisitions are largely non-significant and not tabulated for the sake of brevity.

Table 8
Effects of clawback provisions on overinvestment and underinvestment in R&D and capex.

Panel A: Regression results for the total matched sample

	Dependent Variable =					
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLE	$OverR\&D_{t+1}$	$UnderR\&D_{t+1}$	$OverCapex_{t+1}$	$UnderCapex_{t+1}$	$OverCapex + R\&D_{t+1}$	$UnderCapex + R\&D_{t+1}$
Post	0.010	−0.065**	−0.035	0.027	−0.031	−0.009
	(0.38)	(−2.17)	(−1.00)	(0.91)	(−0.91)	(−0.24)
Clawback*Post	**−0.028**	**0.066****	**0.038**	**−0.025**	**0.023**	**0.025**
	(−0.91)	**(2.18)**	**(1.16)**	**(−0.81)**	**(0.77)**	**(0.74)**
Institutional	−0.037	−0.105	0.076	−0.050	0.181**	−0.127
	(−0.54)	(−1.61)	(0.85)	(−0.90)	(2.44)	(−1.49)
Analysts	0.001	0.010***	−0.001	−0.003	0.000	0.001
	(0.43)	(3.19)	(−0.52)	(−1.24)	(0.15)	(0.49)
G-Score	0.021	0.005	−0.052*	0.031	0.003	0.042
	(0.64)	(0.21)	(−1.78)	(1.05)	(0.09)	(0.82)
G-Dummy	0.018	0.051	−0.258	0.226	0.098	0.287
	(0.07)	(0.27)	(−1.46)	(0.67)	(0.46)	(0.54)
AccrualQuality	−0.508	−0.110	0.194	0.090	0.343	0.335
	(−1.64)	(−0.45)	(0.51)	(0.27)	(1.16)	(1.06)
SalesGrowth	−0.000	0.001	−0.000	0.001**	−0.000	0.001
	(−0.31)	(1.10)	(−0.69)	(2.26)	(−0.40)	(1.44)
LogAsset	−0.249***	0.126**	−0.029	0.032	−0.199***	0.120**
	(−4.53)	(2.40)	(−0.61)	(0.64)	(−4.03)	(2.25)
Q	−0.037	0.024	0.036	0.048**	−0.024	0.024
	(−1.50)	(0.83)	(1.45)	(2.14)	(−1.15)	(0.82)
StdCFO	1.093*	0.061	0.773	0.120	−0.049	−0.897**
	(1.95)	(0.14)	(1.54)	(0.29)	(−0.09)	(−1.99)
StdSale	−0.348**	0.200	−0.353**	0.166	−0.207*	0.543***
	(−2.15)	(1.06)	(−2.13)	(1.25)	(−1.70)	(2.82)
StdInvestment	−0.001	−0.001	0.001	−0.002	0.001	−0.003**
	(−0.64)	(−0.45)	(0.61)	(−1.46)	(0.79)	(−2.10)
Z-Score	0.009	0.028	0.003	−0.014	0.033	0.024
	(0.37)	(1.27)	(0.10)	(−0.55)	(1.50)	(1.00)
Tangibility	0.036	0.087	0.019	−0.128	−0.085	−0.140
	(0.25)	(0.68)	(0.12)	(−0.95)	(−0.69)	(−1.02)
K-structure	−0.012	0.129	−0.331*	0.225	−0.248*	0.038
	(−0.09)	(0.88)	(−1.75)	(1.58)	(−1.74)	(0.26)
Ind-K-Structure	0.001	−0.209	−0.186	−0.317*	−0.201	−0.303
	(0.01)	(−1.13)	(−0.88)	(−1.87)	(−1.49)	(−1.36)
Slack	−0.972***	1.302***	0.076	−0.419***	−0.596***	0.817***
	(−5.63)	(6.19)	(0.47)	(−2.97)	(−4.28)	(4.66)
CFOsale	0.189	0.373**	0.139	−0.051	0.409***	0.142
	(1.14)	(2.24)	(1.01)	(−0.36)	(3.25)	(0.92)
Dividend	0.039	−0.004	−0.012	−0.158***	0.014	−0.065
	(1.07)	(−0.08)	(−0.23)	(−2.77)	(0.33)	(−1.22)
OperatingCycle	0.102*	−0.068	0.091	−0.041	0.047	−0.147**
	(1.84)	(−1.17)	(1.43)	(−0.67)	(0.90)	(−2.38)
Losses	0.039	0.003	0.014	0.002	0.003	0.041
	(1.15)	(0.15)	(0.40)	(0.08)	(0.10)	(1.38)
Age	−0.021	−0.025	0.013	0.026	0.026	−0.016
	(−0.39)	(−0.73)	(0.35)	(1.21)	(0.73)	(−0.64)
Lagged Capex	0.000	0.001	0.032***	−0.012***	0.011**	−0.005
	(0.04)	(0.46)	(5.28)	(−3.47)	(2.53)	(−0.93)
Lagged R&D	0.006*	−0.005	0.003	0.003	0.005*	−0.005**
	(1.72)	(−1.41)	(1.17)	(0.77)	(1.82)	(−2.10)
Lagged AQC	−0.002	0.000	−0.001	0.001	−0.001	−0.000
	(−1.23)	(0.23)	(−0.91)	(0.60)	(−0.58)	(−0.04)
MissR&D	−0.009	0.086	0.034	0.074	0.094	0.098
	(−0.16)	(1.33)	(0.23)	(1.00)	(1.55)	(1.23)
PerfPayRatio	0.001	0.000	0.001	0.000	0.000	0.001*
	(0.89)	(0.43)	(0.82)	(0.02)	(0.15)	(1.77)
EquityIncent	0.001	0.002*	−0.002**	0.000	−0.000	0.001
	(0.76)	(1.68)	(−2.37)	(0.39)	(−0.62)	(0.91)
RiskTolerance	−0.001	−0.001	0.002	−0.000	0.001	−0.001
	(−0.70)	(−0.52)	(1.42)	(−0.36)	(0.58)	(−0.29)
CEO tenure	−0.002	0.002	0.006*	0.001	0.003*	0.000
	(−0.60)	(1.06)	(1.89)	(0.48)	(1.72)	(0.11)
Constant	2.135	−0.241	−0.196	−0.725	0.876	0.029
	(1.43)	(−0.25)	(−0.18)	(−1.00)	(0.90)	(0.03)

(*continued on next page*)

Table 8 (*continued*)

Panel A: Regression results for the total matched sample

	Dependent Variable =					
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLE	$OverR\&D_{t+1}$	$UnderR\&D_{t+1}$	$OverCapex_{t+1}$	$UnderCapex_{t+1}$	$OverCapex + R\&D_{t+1}$	$UnderCapex + R\&D_{t+1}$
Observations	1257	1257	1257	1257	1257	1257
Adjusted R-squared	0.137	0.213	0.089	0.071	0.093	0.116
Firm fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Standard errors clustered by firm	YES	YES	YES	YES	YES	YES

Panel B: High versus low CEO performance-based pay ratios before clawback adoption

	Dependent Variable =			
	$UnderR\&D_{t+1}$		$OverCapex_{t+1}$	
	(1)	(2)	(3)	(4)
VARIABLE	*HighPerfPay*	*LowPerfPay*	*HighPerfPay*	*LowPerfPay*
Post	−0.133***	−0.035	−0.041	−0.014
	(−2.68)	(−0.92)	(−0.75)	(−0.28)
Clawback*Post	**0.101****	**0.076***	**0.040**	**0.037**
	(2.13)	**(1.73)**	**(0.87)**	**(0.82)**
Control variables	Included	Included	Included	Included
Observations	587	670	587	670
Adjusted R-squared	0.260	0.227	0.075	0.109
Firm fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Standard errors clustered by firm	YES	YES	YES	YES
High versus Low PerfPay				
Difference in Clawback*Post	0.025		−0.038	
(*p*-value)	(0.150)		(0.819)	

Panel C: High versus low CEO equity incentives before clawback adoption

	Dependent Variable =			
	$UnderR\&D_{t+1}$		$OverCapex_{t+1}$	
	(1)	(2)	(3)	(4)
VARIABLE	*HighEquity*	*LowEquity*	*HighEquity*	*LowEquity*
Post	−0.058	−0.068	−0.091**	0.003
	(−1.52)	(−1.39)	(−2.03)	(0.05)
Clawback*Post	**0.076***	**0.047**	**0.104****	**−0.034**
	(1.76)	**(1.14)**	**(2.45)**	**(−0.64)**
Control variables	Included	Included	Included	Included
Observations	684	573	684	573
Adjusted R-squared	0.198	0.266	0.148	0.110
Firm fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Standard errors clustered by firm	YES	YES	YES	YES
High versus Low Equity				
Difference in Clawback*Post	0.029		0.138	
(*p*-value)	(0.605)		(0.427)	

This table shows the results of the linear probability regressions of overinvestment (vs. no overinvestment) and underinvestment (vs. no underinvestment) with firm and year fixed effects. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, in a two-tailed test.

Table 8 present the results of estimating Eq. (8) for subsamples partitioned by CEO performance-based pay ratio and equity incentive. Panel B indicates a propensity to underinvest in R&D following clawback adoptions only for the subgroup with high performance-based pay. Panel C indicates propensities to underinvest in R&D and to overinvest in capex following clawback adoptions only for the high equity incentive subsample.[34] Combined, the results in Table 8 lend further support to a positive association between clawback adoptions and capital underinvestment in R&D via a managerial compensation incentive channel.

5.4. Effects of clawback adoptions on managerial equity sales

In Section 2.2., we observe that managers with high equity incentive levels tend to diversify their firm-specific exposure by selling vested equity, thereby motivating an increase in real earnings manipulation after the adoption of clawback provisions. We test this relationship by merging our final sample with CEO equity sales data, resulting in a sample of 183 firms and 509 firm-year observations; the sample is smaller than our main sample due to the limited availability of insider trading data.[35] We use these data to find that CEOs whose performance-based compensation levels before clawback adoptions are higher than the sample median sell more of their equity holdings after clawback adoptions. A path analysis confirms that the R&D-to-capex shift in the capital investment mix is significantly associated with the concurrent increase in CEO equity sales following clawback adoptions. We add the caveat that incentives to maximize long-term equity value discourage shifts in the capital investment mix that sacrifice investment efficiency, as conditioned on expected tenure.

6. Robustness tests

6.1. Parallel trend assumption and falsification tests

The difference-in-differences analyses for our propensity score matched sample assume that R&D and capex follow a parallel trend (although not necessarily at equal levels) for adopters and non-adopters before clawback adoptions to effectively isolate the causal effects of clawback adoptions on capital investment mix. Following Angrist and Pischke (2009), we augment Eq. (2) with *Pre*($-n$) and *Clawback*Pre*($-n$), where *Pre*($-n$) equals one if a firm's fiscal year t coincides with the n years ($n = 1, 2, 3$) before the year of clawback adoption, and zero otherwise; to avoid collinearity, we omit *Clawback*Pre*(-1) and *Post*. Panel A of Table 9 confirms that the coefficients on *Clawback*Pre*(-3) and *Clawback*Pre*(-2) are not significantly different from zero for firms with high and low performance-based compensation, consistent with the parallel trend assumption. The coefficient on *Clawback*Post* is negative and significant for the *R&D* regression ($= -0.871$, t-value $= -2.47$) and positive for the *Capex* regression ($= 0.871$, t-value $= 1.78$), lending support to shifts in the capital investment mix from R&D to capex. Panel B of Table 9 indicates parallel trends in R&D and capex before clawback adoptions and in the R&D-to-capex shift in the capital investment mix after clawback adoptions for firms whose CEOs have high equity incentives but not for firms whose CEOs have low equity incentives.

In addition, we perform a falsification test. Following Roberts and Whited (2013), we create false clawback adoption events by setting the year of clawback adoption to three years before the actual adoption year. Our results disappear in the regressions with the false clawback adoption events, thus supporting the observed effects of clawback adoptions on capital investment mix and capital investment efficiency.[36]

6.2. Regressions for the entire matched sample with both R&D and non-R&D intensive firms

Panel D of Table 1 shows that our matched sample of R&D intensive firms is concentrated in manufacturing industries. To assess the generalizability of our findings to the population of clawback adopters, we examine how clawback adoptions affect R&D and capex for the entire matched sample. The untabulated results confirm R&D reductions and capex increases for firms with high performance-based compensation, consistent with the results reported in Table 3, although weaker in this case due to the inclusion of firms with low R&D intensity.

6.3. Regressions using an entropy-balanced unmatched sample

Although propensity score matching is effective in a non-linear function of covariates associated with clawback adoptions, it inevitably loses a substantial number of observations. To assess the generalizability of our findings to the unmatched population of clawback adopters, we examine how clawback adoptions affect R&D and capex for the unmatched sample after entropy balancing. The entropy balancing method adjusts the covariate distribution of control firms by fitting weights to balance the distribution of covariates

[34] In Table 8, the chi-square test results indicate non-significant differences in the coefficients on *Clawback*Post* between high versus low performance-based pay subsamples and between high versus low equity incentive subsamples. We conjecture that the non-significant coefficients are partially due to the small number of observations in the intersecting samples of overinvestment (or underinvestment), clawback, post, and high versus low managerial incentives.

[35] We do not tabulate the results to avoid any exaggeration based on the small number of observations. These results are available from the authors upon request.

[36] For the sake of brevity, we do not tabulate the results of this falsification test. The results are available from the authors upon request.

Table 9
Results of testing the parallel trend assumption.

Panel A: High versus low CEO performance-based pay ratios before clawback adoption

	Dependent Variable =					
	R&D$_{t+1}$		*Capex*$_{t+1}$		*Capex + R&D*$_{t+1}$	
VARIABLE	HighPerfPay (1)	LowPerfPay (2)	HighPerfPay (3)	LowPerfPay (4)	HighPerfPay (5)	LowPerfPay (6)
Pre(−3)	−0.892	0.771	0.930	0.345	0.039	1.025
	(−1.47)	(1.59)	(1.30)	(0.65)	(0.04)	(1.29)
Clawback*Pre(−3)	**0.214**	**0.414**	**−0.183**	**0.363**	**0.036**	**0.709**
	(0.42)	**(1.14)**	**(−0.39)**	**(0.94)**	**(0.05)**	**(1.27)**
Pre(−2)	−1.009**	1.068**	0.225	0.669	−0.787	1.662**
	(−2.37)	(2.41)	(0.45)	(1.47)	(−1.14)	(2.34)
Clawback*Pre(−2)	**0.487**	**−0.444**	**0.285**	**−0.358**	**0.765**	**−1.014**
	(1.52)	**(−1.16)**	**(0.62)**	**(−0.87)**	**(1.18)**	**(−1.51)**
Pre(−1)	−0.607*	0.379	0.766	0.157	0.161	0.449
	(−1.74)	(1.47)	(1.41)	(0.51)	(0.22)	(1.00)
Clawback*Post	**−0.871****	**−0.124**	**0.871***	**−0.000**	**0.002**	**−0.188**
	(−2.47)	**(−0.42)**	**(1.78)**	**(−0.00)**	**(0.00)**	**(−0.41)**
Control variables	Included	Included	Included	Included	Included	Included
Observations	587	670	587	670	587	670
Adjusted R-squared	0.410	0.442	0.331	0.286	0.372	0.387
Firm fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Standard errors clustered by firm	YES	YES	YES	YES	YES	YES
High versus Low PerfPay						
Difference in Clawback*Post	**−0.747***		**0.871**		**0.190**	
(*p*-value)	**(0.092)**		**(0.111)**		**(0.807)**	

Panel B: High versus low CEO equity incentives before clawback adoption

	Dependent Variable =					
	R&D$_{t+1}$		*Capex*$_{t+1}$		*Capex + R&D*$_{t+1}$	
VARIABLE	HighEquity (1)	LowEquity (2)	HighEquity (3)	LowEquity (4)	HighEquity (5)	LowEquity (6)
Pre(−3)	−0.704	0.623	0.570	0.511	−0.131	1.023
	(−1.43)	(1.13)	(0.95)	(0.99)	(−0.17)	(1.26)
Clawback*Pre(−3)	**0.035**	**0.408**	**0.518**	**−0.548**	**0.551**	**−0.167**
	(0.09)	**(0.99)**	**(1.14)**	**(−1.26)**	**(0.87)**	**(−0.24)**
Pre(−2)	−0.489	1.019***	0.600	0.226	0.110	1.189*
	(−1.22)	(2.78)	(1.36)	(0.57)	(0.18)	(1.95)
Clawback*Pre(−2)	**−0.153**	**−0.158**	**−0.046**	**−0.202**	**−0.204**	**−0.631**
	(−0.52)	**(−0.44)**	**(−0.11)**	**(−0.47)**	**(−0.36)**	**(−0.86)**
Pre(−1)	−0.397	0.454*	0.672*	0.088	0.274	0.452
	(−1.44)	(1.70)	(1.78)	(0.27)	(0.52)	(0.96)
Clawback*Post	**−0.805*****	**0.299**	**0.792****	**−0.165**	**−0.019**	**0.075**
	(−2.75)	**(0.90)**	**(2.19)**	**(−0.49)**	**(−0.04)**	**(0.15)**
Control variables	Included	Included	Included	Included	Included	Included
Observations	684	573	684	573	684	573
Adjusted R-squared	0.433	0.484	0.279	0.324	0.386	0.393
Firm fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Standard errors clustered by firm	YES	YES	YES	YES	YES	YES
High versus Low Equity Incentives						
Difference in Clawback*Post	**−1.104*****		**0.957****		**−0.094**	
(*p*-value)	**(0.010)**		**(0.044)**		**(0.470)**	

This table tests the parallel trends of R&D and capex. *Pre(−n)* is one for year *t-n* (where $n = 1, 2, 3$) for a clawback-adopting firm and its control firm, and zero otherwise. *T* is the adoption year for an adopter and the pseudo-adoption year for its control firm. *Clawback*Pre(−n)* is one for year *t-n* for an adopter, and zero otherwise. To avoid perfect collinearity, the regression models omit *Clawback*, *Clawback*Pre(−1)*, and *Post*. See Appendix B for variable definitions. *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively, for two-tailed tests.

between the treatment and control firms, thus helping mitigate selection bias for the treatment effect analysis (Hainmueller, 2012). We apply entropy balancing to the mean and variance of each covariate of the clawback adoption model and to examine shifts in the capital mix surrounding clawback adoptions in the entropy-balanced unmatched sample with differing numbers *t*-3 to $t + 3$ observations for non-adopters. Despite the resulting lower power, untabulated results are qualitatively similar to the results using the matched sample in indicating shifts in capital investment mix from R&D to capex after clawback adoptions that are more prominent for firms with higher percentages of performance-based pay to CEO total annual pay, and insignificance remaining for the sum of R&D and capex consistent with capital investment mix shifts.

6.4. Regressions without CEO turnover before clawback adoptions

Hiring a new CEO may be a motive for adopting a clawback provision in a particular year, and a new CEO may implement a new investment strategy. Our regression models above control for CEO tenure, firm fixed effects, and firm cluster effects, but not for the possible effects of CEO turnover. We re-estimate the regressions using firms that do not experience CEO turnover throughout our sample period, with findings qualitatively similar to our main results.

7. Conclusion

This study provides evidence that the voluntary adoption of clawback provisions induces CEOs with high performance-based compensation to shift capital investment mix from R&D to capex to a greater extent than CEOs with low performance-based compensation, and that these compensation-driven shifts in capital investment mix are associated with reductions in capital investment efficiency. These findings covary with R&D intensity, hold for both annual performance-based pay and equity incentives, and are more (less) pronounced for firms prone (less prone) to financial misreporting, consistent with board incentives to adopt clawbacks and with CEOs substituting real for accrual-based earnings management in response. Path analyses confirm performance-based compensation incentives as a mediating channel of the effect of clawback adoptions on R&D-to-capex shifts in capital investment mix and efficiency changes after controlling for risk and earnings management. These findings are robust to changes in performance-based compensation, risk controls, CEO turnover, and adoption-year randomization.

Our results extend the literature in several ways. First, they augment evidence regarding the real effects of clawback adoptions on capital investment decisions by including performance-based compensation incentives. Second, they extend findings regarding capital investment efficiency to include the effects of shifts in the capital investment mix induced by clawback adoptions via compensation incentives. Third, our results clarify that evidence of R&D reductions associated with clawback adoptions can be related to broader shifts in capital investment mix, which are associated with performance-based compensation incentives. Fourth, our results provide evidence that the financial reporting quality effects of clawback adoptions, a purported and documented benefit, are countervailed in their effects on capital investment efficiency by performance-based compensation incentives, all caveated on potentials for endogeneity.

Finally, our findings that in response to clawback provision adoptions, managers shift capital investment mix from R&D to capex as motivated by performance-based compensation incentives, thereby reducing capital investment efficiency, are relevant and timely given the recent issuance of SEC Rule 10D-1 to implement Section 954 of the Dodd–Frank Act (U.S. House of Representatives, 2010) that requires clawback provision adoptions as a condition of U.S. stock exchange listings. In promulgating Rule 10D-1, the SEC cogently observed that “while [clawback provisions] could result in high-quality financial reporting that would benefit investors, they may also alter operating decisions of executive officers” (SEC, 2015, 103–104), as our findings confirm. The SEC also explicitly requested “comment on any effect the proposed requirements may have on efficiency, competition and capital formation,” which this study provides as revised Rule 10D-1 becomes effective in November 2023 with this study cited (SEC, 2022, 454).

Data availability

Clawback data are from Corporate Library and other data are from public sources.

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Appendix A. A real-world example of clawback provisions

Advanced Micro Devices, Inc. FY 2010, DEF-14 A, Filing Date 3/10/2011.

AMD adopted the following clawback provisions/policies:

- *Form of Stock Option and Restricted Stock Unit Agreements*. For stock option and restricted stock unit awards granted in May 2010 and thereafter, the Compensation Committee approved the inclusion of a “claw-back” provision in AMD’s form of stock option agreement and form of restricted stock unit agreement for senior vice presidents and above, which includes all of the Named Executive Officers. This claw-back provision provides that in the event AMD is required to prepare an accounting restatement due to AMD’s material noncompliance with any financial reporting requirement under the securities laws, the Compensation Committee will review all equity-based compensation awarded to any employee at the senior vice president level and above. If the Compensation Committee (in its sole discretion) determines that any such employee was directly involved with fraud, misconduct, and/or gross negligence that contributed to or resulted in such accounting restatement, the Compensation Committee may, to the

extent permitted by governing law and as appropriate under the circumstances, recover for the benefit of AMD all or a portion of the equity-based compensation awarded to such employee, including, without limitation, by cancelation, forfeiture, repayment, and/or disgorgement of profits realized from the sale of AMD's securities; provided, however, the Compensation Committee will not have the authority to recover any equity-based compensation awarded >18 months prior to the date of the first public issuance or filing with the Securities and Exchange Commission (whichever first occurs) of the financial document embodying such financial reporting requirement.
- *Worldwide Standards of Business Conduct*. In November 2010, AMD amended its Worldwide Standards of Business Conduct to provide that, among other things, in the event AMD is required to prepare an accounting restatement due to AMD's material noncompliance with any financial reporting laws, AMD may pursue all remedies to recover any incentive-based or other compensation (including equity awards) paid or granted to its employees or agents to the extent required by and permitted under applicable law.

AMD continues to monitor the rule-making actions of the SEC and NYSE with respect to the development, implementation, and disclosure of claw-back procedures/policies. AMD intends to revise its claw-back provisions/policies in the future as required by applicable law.

Appendix B. Variable definitions

Variable	Description
Propensity score matching variables	
Clawback	An indicator variable for the first adoption of a clawback provision (equals 1 in the year a firm adopts a clawback provision, and 0 otherwise)
LogAsset	Natural logarithm of the book value of total assets
Lev	Leverage ratio (measured as total debt deflated by total assets)
ROA	Return on total assets (measured as income before ordinary items deflated by the lagged book value of total assets)
MB	Market-to-book ratio for common equity (measured as the market value of common equity deflated by the book value of common equity)
LogSegment	Log of the number of business segments
Restate_prior_3y	An indicator variable for prior restatement (equals 1 if a firm's financial statements were restated from year *t*-3 to year *t*-1, where year *T* is the adoption year, and 0 otherwise)
Independence	Board independence (measured as the percentage of independent directors on the board of directors)
Institutional	Institutional ownership measured as a percentage of firm shares held by institutional investors
Boardmeeting	The number of board meetings held in a year
Auditsize	The number of directors on the audit committee of the board of directors
Insiderowen	Insider equity ownership
Capital investment regressions	
Clawback	An indicator variable for clawback adopters that equals one if a firm is in the treatment group (clawback adopters) and zero if a firm is in the control group (non-adopters)
Post	An indicator variable for the post-adoption period (equals one for firm-years when clawback provisions are in place, and zero otherwise. A pseudo-adoption year is assigned to a non-adopter)
Clawback × *Post*	An indicator variable for the post-adoption period for clawback adopters (equals one for firm-years after a firm adopts clawback provisions in year *t*, and zero otherwise)
Investment	One-year-ahead net investment (capital expenditure – cash receipts from sale of property, plant, and equipment + acquisitions + R&D expenditure) multiplied by 100 and deflated by current-year total assets
Capex	One-year-ahead capex net of cash receipts from sale of property, plant, and equipment multiplied by 100 and deflated by current-year total assets
R&D	One-year-ahead R&D expenditure (i.e., the higher of R&D expenditure and zero) multiplied by 100 and deflated by current-year total assets
Acquisition	One-year-ahead acquisitions multiplied by 100 and deflated by current-year total assets
Q_{IND}	An industry-year average of total q (based on three-digit SIC codes). Total q is a novel Tobin's q proxy that accounts for tangible and intangible capital (Peters and Taylor, 2017)
RQ	The firm-specific output elasticity of R&D (referred to as the research quotient), which is measured as the ability of current-year R&D to predict future revenue after controlling for other production function factors (Knott, 2008)
OCF	Operating cash flow before R&D expenditure, measured as net cash generated by operating activities (reported in the financial statements) plus R&D expenses deflated by lagged total assets
PerfPayRatio	The percentage ratio of performance-based components to CEO annual total pay for the current year. Performance-based pay is measured as annual total pay minus annual salary
EquityIncent	*Delta* times 100 divided by the sum of *Delta* and cash pay for the current year, where *Delta* is the sensitivity of the CEO's share and option portfolio value to share returns
HighPerfPay (LowPerfPay)	An indicator variable for firms paying high (low) performance-based compensation. If a firm's mean *PerfPayRatio* for the three years immediately before the adoption year is higher (lower) than the median of all sample firms for the same pre-adoption period, the firm is classified as *HighPerfPay* (*LowPerfPay*)
HighEquityInc (LowEquityInc)	An indicator variable for firms paying high (low) short-term equity incentives. If a firm's mean *EquityIncent* for the three years immediately before the adoption year is higher (lower) than the median of all sample firms for the same pre-adoption period, the firm is classified as *HighEquityInc* (*LowEquityInc*)
Institutional	Institutional ownership measured as a percentage of firm shares held by institutional investors

(*continued on next page*)

(*continued*)

Variable	Description
Analysts	Analyst coverage measured as the number of analysts following the firm, as provided by I/B/E/S
G-Score	Governance score (measured by the strength of anti-takeover protection created by Gompers et al. (2003), multiplied by minus one)
G-Dummy	An indicator variable for firm-year observations with missing G-Score values
AccrualQuality	The standard deviation of the firm-level residuals of working capital accruals from an estimation of the Dechow and Dichev (2002) model for year *t*-4 to year *t*, multiplied by minus one
SalesGrowth	Percentage change in sales from year *t*-1 to year *t*
LogAsset	Firm size measured as the log of the book value of total assets
Q	A proxy for Tobin's q measured as the market value of total assets deflated by the book value of total assets at the end of year *t*
StdCFO	The standard deviation of cash flow from operating activities deflated by average total assets from year *t*-5 to year *t*-1
StdSale	The standard deviation of sales divided by mean total assets from year *t*-5 to year *t*-1
StdInvestment	The standard deviation of total capital investment (*Investment*) from year *t*-5 to year *t*-1
Z-score	A proxy for bankruptcy risk based on Altman (1968) Z-score formula
Tangibility	The ratio of the book value of property, plant, and equipment to the book value of total assets
K-structure	The capital structure measured as the book value of long-term debt/(book value of long-term debt + the market value of equity)
Ind-K-Structure	The industry capital structure measured as the average of the K-structure for all Compustat firms in the same three-digit SIC code industry in a given year
Slack	The ratio of cash and cash equivalents to total assets
CFOsale	The ratio of operating cash flow to sales
Dividend	An indicator variable that takes a value of one if a firm pays a common or preferred dividend, and zero otherwise
OperatingCycle	The log of receivables to sales plus inventory to the cost of goods sold times 360
Losses	An indicator variable that takes a value of one if net income before extraordinary items is negative, and zero otherwise
Age	The number of years that have passed since the firm appears in CRSP
MissR&D	An indicator variable for firm-years with R&D expenses missing (Koh and Reeb, 2015)
RiskTolerance	*Vega* times 100 divided by the sum of *Vega* and cash pay for year *t,* where *Vega* is the sensitivity of the CEO's share and option portfolio value to share return volatility
Tenure	The duration of employment as the permanent CEO of a given firm
Compensation incentive structure regressions	
PerfPayRatio	The percentage of performance-based components in CEO annual total pay for the current year
EquityIncent	*Delta* times 100 divided by the sum of *Delta* and cash compensation for the current year
RiskTolerance	*Vega* times 100 divided by the sum of *Vega,* salary, and bonus for year *t*
ROA	One-year-ahead accounting return on total assets (net income before extraordinary items and discontinued operations deflated by lagged total assets)
RET	One-year-ahead annual market-adjusted share returns
VOLROA	The standard deviation of return on assets over the previous five years
VOLRET	The standard deviation of share returns over the previous five years
Q	The firm's year-end market value of total assets deflated by the book value of total assets
Salechg	The percentage rate of sales growth from year *t* to year *t* + 1
LogSale	The natural logarithm of sales revenue during year *t* + 1
R&D	R&D expenses deflated by total assets in year *t* + 1
The likelihood of financial misreporting	
HighEM (LowEM)	An indicator variable for firms that are more likely to manipulate earnings. We perform principal component analyses for (1) discretionary accruals (Dechow et al., 1995); (2) real activities manipulation (Roychowdhury, 2006); (3) the fraud score (Dechow et al., 2011); (4) AAERs; (5) restatements due to non-clerical errors; and (6) internal control weakness disclosures. Next, we classify a firm as having a high (low) likelihood of earnings manipulation if its average probability of earnings manipulation is higher than (less than or equal to) the sample median before the firm's (pseudo) year of adopting a clawback provision.

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