Bonus incentive plans and innovation

Rebecca L. Bachmann

Macquarie University

Anna Bedford*

University of Technology Sydney

Le Ma

University of Technology Sydney

We examine whether bonus incentive plans are designed to motivate long-term investment decisions, such as, corporate innovation. We find that the degree of cost shielding used in financial performance targets is positively associated with innovation. We also find a positive association between the use of non-financial performance targets that explicitly reward risk taking and corporate innovation. This finding supports the argument that non-financial performance targets are forward-looking and informative. Moreover, we find the deferral of cash bonuses is negatively associated with corporate innovation. Overall, these results dismiss prior assumptions that bonuses encourage short-termism and bad behaviors, and highlight how bonus contracts can be tailored to incentivize long-term innovative activities. Finally, further analysis indicates that there is a complementary effect between the bonus and equity compensation on corporate innovation.

*Corresponding author

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1. Introduction

How do firms motivate managers to innovate? The answer to this question is important given that performance and even survival of many firms depends on their ability to innovate (Schumpeter 1951). Incentivising managers to innovate is critical because managers tend to focus on short term performance rather that engage in riskier innovation activities which involves the exploration of new endeavours with a high likelihood of failure. The academic literature suggests that one avenue to motivate innovation and reduce managerial myopia, is through the use of long-term equity-based incentive compensation (Francis et al. 2011; Manso 2011; Laux 2015; Mao and Zhang 2018). Specifically, granting restricted stock and options that are not immediately exercisable, tie the compensation of managers to the long-term performance of the firm. Meanwhile, short-term incentive compensation, such as bonuses have been criticised to encourage short-termism (Healy 1985; Holthausen et al. 1995; Jensen and Murphy 2011) and there is little theory and empirical evidence to date on whether bonus incentive plans are relevant for corporate innovation. Yet, a vast majority of firms continue to incorporate cash bonuses in executive pay (Guay et al. 2021), suggesting that firms benefit from these plans. This leads to the question of why firms continue to use bonus incentive plans and whether they can be designed to stimulate corporate innovation?

We argue that bonus incentive plans motivate corporate innovation through two channels: the communication of the firm's risk-taking strategy and reward for innovation effort under the CEO's control (Holmström 1979; Guay et al. 2019; Bloomfield et al. 2021; Bushman 2021). This is in contrast to other types of compensation incentives, for example, equity-based incentive plans that rely on future share prices affected by events that are outside of the CEO's control (Grossman and Stiglitz 1980; Sloan 1993).[1] Specifically, our study examines three features of CEO bonus incentive plans: (1) the degree of cost shielding in the choice of financial performance targets, (2) the use of non-financial performance targets incentivizing risk-taking and (3) deferral of bonus payments, and their impact on corporate innovation. These features are commonly employed in bonus incentive plans but their impact on executives' incentives to invest in long-term risky projects is not well understood. Our study fills this current void in the academic literature.

[1] Moreover, Murphy and Jensen (2011) argue that by using performance targets that are directly linked to executives' decisions, '*bonus plans may well provide stronger incentives than equity-based plans, even when the magnitude of the payoff is smaller*'.

In terms of financial performance targets, empirical evidence suggests that earnings-based performance targets are commonly used and create managerial short-termism and myopic behaviors such as manipulating earnings and cutting long-term profitable projects (e.g., Healy 1985; Holthausen et al. 1995; Jensen and Murphy 2011). However, firms commonly use various income statement measures beyond net profit as financial targets in executives' bonus plans.[2] These financial targets include operating revenues, earnings before interest, tax, depreciation and amortization (ebitda), and cash flow from operations, with the main difference amongst them being the extent to which these financial performance targets exclude particular expenses or costs (Bloomfield et al. 2021). The practice of using income statement items that exclude certain costs, is referred to as, cost shielding. As investment in innovation requires upfront costs with delayed benefits, managers are likely to underinvest in innovative activities if the financial performance targets do not provide shielding from such costs (Bloomfield et al. 2021). To encourage risk-taking and investment in long-term innovative projects, we argue that firms shield managers from innovation related costs. Therefore, we predict a positive association between the use of cost shielding in financial targets and corporate innovation.

Turning to non-financial performance targets, prior literature has criticised their use as subjective and less verifiable and hence used to extract excess compensation (Bartov 1993; Murphy and Oyer 2001). However, others have argued that non-financial targets can be forward-looking and informative by capturing various aspects of managerial effort (e.g., good leadership, hiring decisions, strategy), not otherwise captured by financial performance targets (Bushman et al. 1996; Gibbs et al. 2004; Ittner and Larcker 2009; Höppe and Moers 2011). According to Jensen and Murphy (2011), all bonus plans should incorporate a subjective non-financial component. Their inclusion can reduce value destruction for those managers that play the system and manipulate financial performance targets. Following these studies, we argue that innovative firms use non-financial performance targets to motivate managers' innovation effort and reward managers for upfront innovation investments costs that are viewed as value maximising irrespective of future financial outcomes as decisions might fail despite the best effort of managers. Therefore, we predict that firms strategically use non-financial targets that provide direct information about CEOs' innovation effort, to motivate and reward corporate innovation.

[2] Most of the academic literature have focused on the manipulation of net profit/earnings to achieve bonus payout (e.g., Holthausen, Larcker and Sloan 1995).

Another feature of bonus incentive plans that has not previously received attention in the academic literature is bonus deferral. Bonus deferral occurs when a proportion of bonus payments is not paid to the CEO in the year it is earned but instead converted into equity which can be accessed by the CEO in two to three years. Prior studies have long proposed payment deferrals to promote long-term orientation in managers' decision-making. In this aspect, the literature has extensively examined the use of equity-based compensation, for example, shares and stock options, to align the investment horizon and risk preferences between managers and shareholders (Mao and Zhang 2018; Francis et al. 2011; Manso 2011). Following the same argument, delayed payment of bonuses to managers over a pre-specified period, is also considered to have the benefits of retaining talents and motivating long-term decision-making (Cheng et al. 2018). On the other hand, deferring bonus payout for effort that has been achieved can create uncertainty and complexity for risk-averse managers (Balkin et al. 2000; Cheng et al. 2018). Hence its value can be significantly discounted, providing little incentives for, or even demotivating innovation effort. Therefore, it remains an open empirical question whether the deferral of bonus payments impacts corporate innovation.

We conduct our analyses in the Australian settings for a number of reasons. First, prior literature (e.g., Bachmann et al. 2020) documents that the compensation design of Australian listed firms is much more diverse than U.S peers, such as more varied performance targets used for short-term incentives, hence providing us with the data to conduct detailed and meaningful analyses. In particular, compared to the U.S setting where only 42% of firms make the payment of a bonus contingent on meeting specific performance hurdles, almost all Australian firms set and disclose a number of performance targets used in bonus contracts including non-financial ones (Hill et al. 2011).[3] Second, unlike the U.S setting where almost all listed firms use some forms of equity-based compensation, only around 75 percent of firms in Australia offer an equity-based compensation component to their CEO (Bachmann et al. 2021). This raises an important question on whether and how bonus contracts can act as an alternative to or complement the use of stock options and restricted stock to motivate innovation. Third, there are two possible explanations regarding what incentivizes CEOs to innovate in the U.S setting, the use of anti-takeover provisions that provides protection for early failures and compensation incentives as reward for future performance. Given that anti-takeover provisions do not exist in the Australian setting, we are able to more confidently attribute our results to compensation

[3] On average, Australian firms include 1.39 hurdles per contract whereas U.S firms only include 0.49 hurdles per contract (Hill et al. 2011).

incentives as drivers of corporate innovation. These variations in the research setting provide a unique opportunity to study the incentive effects of different compensation designs. Moreover, while Guay et al. (2019) uses U.S data detailing the performance targets used in bonus contracts, they do not consider why firms choose the specific performance target which we address in this study.

Using a sample of 1,318 firm-year observations from 2004 to 2018, we find that the typical firm attributes 62 percent of the CEO's bonus plan towards achieving financial performance targets (this corresponds to around 23 percent of total compensation). However, substantial variation can be observed in the types of performance metrics firms choose to focus on. For example, while many firms focus on specific profit targets (around 25 percent, not tabulated), relatively few include performance targets related to revenue (around 8 percent, not tabulated). Consistent with our expectation, we find that incorporating cost shielding performance targets in the bonus incentive plans is positively associated with future firm innovation in terms of patent applications and new product announcements. Furthermore, we find that incorporating risk taking incentives in non-financial performance targets also has a positive impact on corporate innovation. Interestingly, we also find that many firms choose to defer a significant component of the bonus to subsequent periods. Although such actions may incentivize a long-term focus, our result suggests that they achieve the opposite, in the context of corporate innovation. In other words, we find that deferral of the bonus is negatively associated with future patent applications and new product announcement.

In additional analyses we find that the combined use of bonus incentives and long-term incentives has a positive impact on corporate innovation. In other words, this finding suggests that bonus and long-term incentive compensation are complementary. We further disaggregate bonus into financial versus non-financial targets, more cost shielding financial versus less cost shielding financial targets. We also disaggregate long-term incentive pay into financial versus market-based targets. We find that the aggregate use of financial bonus targets and market-based long-term incentive compensation explains this result. Furthermore, we find that the combined use of non-financial target in bonus plans and market-based measures in long-term incentive plans have a substitutive effect on corporate innovation as both capture forward looking incentives.

Overall, our paper contributes to the innovation and compensation literature by documenting how executive bonus incentive plans can be designed to motivate long-term innovation efforts independent of equity-based compensation incentives. It compliments existing research which has predominantly argued for the use of equity compensation, such as,

shares and options as the main incentive contracting mechanism to align the long-term interest between shareholders and managers and to stimulate risk-taking activities (e.g., Mao and Zhang 2018; Francis et al. 2011; Manso 2011). We demonstrate that long-term innovation outcome can be achieved through appropriate designs of bonus incentive plans which have typically been considered to only affect short-term performance. Our findings highlight that bonus plans can be used to communicate and reward managers for their innovative undertakings in a more direct way in comparison to equity-based compensation. Our study supplements the findings of Bloomfield et al. (2021) who focuses on how underinvestment can be avoided by excluding certain costs when setting up financial performance targets in bonus plans. We also incorporate other design features of bonus contracts, including the use of non-financial performance targets and the deferral of bonus payments.

Moreover, this study provides the first empirical evidence on how managerial behaviors can be positively shaped by the use of forward-looking non-financial performance targets in bonus contracts. As non-financial performance targets become gradually prevalent in executive remuneration contracts, there is growing academic debate on its benefits and drawbacks (e.g. Bachmann et al., 2020; Bushman, 2021; Ederhof, 2010; Ittner and Larcker 2009). Our study contributes to this debate by documenting that rather than being exploited by managers to engage in myopic behaviors, non-financial targets can be an effective tool to stimulate value-creation and long-term orientation. Specifically, explicitly rewarding risk-taking in non-financial performance targets are found to encourage more risky and inventive activities.

Finally, being the only empirical study examining the impact of deferred bonus on managerial incentives, we provide the first evidence on the ineffectiveness of delayed compensation payment design in encouraging executives to make long-term investment decisions. This finding challenges the conventional belief in the literature that bonus deferrals promote interest alignment and risk-taking behaviors (Cheng et al. 2019; Hartmann and Slapničar 2015). Instead, it provides support to the theoretical argument that risk-averse managers significantly discount the value of future awards due to uncertainty and hence may be dis-incentivised to undertake risky investment (O'Donoghue and Rabin 1999).

The remainder of this paper is organised as follows. In Section 2, we review the relevant literature and develop empirical predictions. Section 3 outlines the research design and sample derivation. Section 4 presents the findings and Section 5 discusses additional tests. Section 6 concludes this study.

2. Relevant literature and Hypothesis Development

2.1 Relevant literature

From an optimal contracting perspective, the choice of performance targets in compensation plans reflects the CEO's innovation effort and excludes factors that are beyond the CEO's control (Murphy and Oyer 2001). If share price is a noisy proxy for CEO's innovation effort, then bonus incentive plans can improve incentive alignment between managers and shareholders (Holmstrom 1979; Guay et al. 2019). Specifically, performance targets used in bonus plans can incentivize innovation in a more direct way than equity-based compensation.

Recent academic literature has taken a more optimistic view of bonus incentive plans. This literature suggests that bonus incentive plans can motivate innovation through two channels: communication of innovation strategy and reward for innovation effort under the CEO's control. Firstly, bonus incentive plans play an important role in communicating the firm's innovation strategy, to its executives and enhance their accountability through the choice of performance targets and payoffs for achieving targets tied to innovation effort (Guay et al. 2019; Bloomfield et al. 2021; Bushman 2021). Secondly, unlike stock prices that are beyond managerial control (Grossman and Stiglitz 1980; Sloan 1993), bonus incentives plans can be customised to include performance target that captures managerial innovation effort (Holmström 1979; Bloomfield et al. 2021). Specifically, the link between managerial action and reward is clearer under bonus incentive plans, which may provide stronger incentives compared to equity-based incentives. This is specifically important in the context of corporate innovation as investment in innovation is inherently risky, implying variability in future outcomes and a greater probability of failure, making it more difficult to predict future firm performance and stock prices. Overall, through meticulous design of performance targets that reward and recognise managerial effort as they occur, we contend that bonus plans can motivate managers to pursue longer-term goals.

2.2 Hypothesis development

2.2.1 Financial performance targets and corporate innovation

Earlier empirical studies have generally considered bonus plans as deeply flawed resulting in the manipulation of the timing of earnings, excessive risk taking and the forgoing of profitable long-term projects (Healy 1995; Grinstein and Hribar 2004; Bugeja and Loyeung 2015; Bennett et al. 2017). While these studies are informative, they rely on the assumption that bonus incentive plans are purely based on net profit (or financial ratios based on net profit such as, earnings per share, return on assets or return on equity) as the financial performance

target. However, firms use various income statement measures in bonus contracts. These include revenues, earnings before interest and tax, cash flow from operations.

More recent empirical studies have examined the increased tendency of firms using non-GAAP earnings as a key criterion in determining CEO pay. Similar to the concept of cost shielding used in this paper, non-GAAP earnings exclude various expenses and have been documented to be 23% larger than GAAP earnings. Guest et al. (2022) find that when non-GAAP earnings are large compared to GAAP earnings, CEO pay is abnormally high. The study interprets this result to be consistent with managerial opportunism whereby CEOs use their discretion over non-GAAP metrics to make them easier to achieve in order to justify excessive pay that is not explained by the true performance of the firm. Similar findings are reported by Lont et al. (2020). In contrast, Kyung and Yang (2021) find that the use of non-GAAP performance metrics in CEO compensation contract is more prevalent amongst firms with more talented CEOs. The findings in Kyung and Yang (2021) are consistent with efficient contracting. We extend these prior studies by examining instances whereby excluding certain costs in the financial performance targets in bonus plans, can have a positive impact on firms' innovative performance.

Specifically, as immediate investment cost is required in order to innovate, managers are unlikely to be motivated to do so if they are penalised for incurring such costs in the short run when the benefits of the innovation accrue in the long-term. In this instance, reliance on short-term financial targets that are affected by such investment costs, such as net profits, may deter managers from engaging in innovation as they are uninformative of managerial effort. For example, Holmstrom (1989) proposes that firms design compensation schemes that are less sensitive to firm performance, as innovation outcome is noisy and unpredictable. Hence, we argue that firms shield CEOs from particular costs, to achieve better innovation performance. This argument is consistent with Bloomfield et al. (2021) who argue that firms with more growth options and intangible investments mitigate underinvestment problems by choosing financial targets that exclude certain costs. This leads to our first hypothesis in relation to the design of financial performance targets:

H1: The degree of cost shielding in CEO bonus plans is positively associated with corporate innovation.

2.2.2 Non-financial performance targets and corporate innovation

Next, we focus on the use of non-financial targets in bonus incentive plans to motivate innovation. We argue that non-financial performance targets can be used to achieve corporate innovation for a number of reasons. First, non-financial targets can be informative by capturing

various aspects of managerial effort (e.g., good leadership, hiring decisions, strategic vision), not otherwise captured by financial performance targets (Bushman et al. 1996; Ittner and Larcker 2009; Gibbs et al. 2004; Höppe and Moers 2011). Specifically, the use of non-financial performance targets allows the board of directors to acknowledge any additional relevant information about a CEO's innovation effort. Subjectivity in non-financial performance targets can be used to reward innovation effort that are not easily quantifiable in accounting numbers (Gibbs et al. 2004).[4]

Second, non-financial targets are often forward looking which mitigates short term myopic decisions (Murphy and Oyer 2001). According to Jensen and Murphy (2011), all bonus plans should incorporate a subjective non-financial component. Their inclusion can reduce value destruction for those managers that play the system and manipulate financial performance targets in the short-term and instead encourage long-term investments. Using department manager in 250 car dealerships, Gibbs et al. (2004) document evidence consistent with this view, that non-financial performance targets are associated with long-term investments in intangibles. Similarly, Bushman et al. (1996), Hayes and Schaefer (2000) and Murphy and Oyer (2003) argue that the use of non-financial performance targets will be greater in firms with more growth opportunities. Building on those prior studies, we argue that firms use non-financial performance targets to motivate managers to take risks and reward managers for upfront risk-taking initiatives irrespective of future financial outcomes as innovation decisions might fail despite the best effort of managers. Therefore, we predict that firms strategically use non-financial targets that provide direct information about CEOs' innovation effort, to motivate and reward corporate innovation.

H2: The use of non-financial performance targets that explicitly communicate the risk-taking strategy of the firm is positively associated with corporate innovation.

2.2.3 Deferral of bonus payment and corporate innovation

A common problem with bonus plans is that CEOs have incentives to maximize their short-term performance at the expense of long-term performance (Dechow and Sloan 1991). The academic literature has extensively examined the use of stock ownership and stock options to align the interest of managers with those of shareholders. However, evidence suggest that equity-based compensation may induce managerial myopia as opposed to reducing it (e.g., McAnally, Srivasta and Weaver 2008; Bergstresser and Philippon 2006). We argue that an

[4] For example, in 2018, Challenger Group Limited included a non-financial performance target as part of the CEO's key performance indicators in its bonus incentive plan which required the CEO to achieve "successful diversification into new product areas arising from regulatory change and innovation" (Challenger, 2018, p. 34).

alternative approach to reduce managerial myopia is to defer part of executive bonuses. Deferred bonus refers to the delayed payment of bonuses to managers over a pre-specified period of time (Cheng et al. 2018). For example, in the European setting, firms are required to defer approximately 30-40% of bonuses for up to 5 years. In response to the Global Financial Crisis the European Parliament released directive 2010/76/EU directive requiring deferral of financial institutions. This requirement has since been extended to non-financial firms. In a similar vein, clawback and hold back provisions were introduced in the US setting under the Dodd-Frank Act of 2010. While the EU requires deferral and no clawback, the U.S requires clawback and no bonus deferral. Meanwhile Australia has both bonus deferral and clawback provisions, despite the absence of regulatory requirements to do so.[5] The deferred bonus amount is often converted into equity with a deferral period of one to three years. Descriptive evidence suggests that the popularity of bonus deferrals in Australia started in 2011 which coincides with regulatory changes in the EU and the U.S.

Empirical evidence on the consequences of bonus deferral is rare. On the one hand, economic theory suggests that managers are indifferent to the timing of bonuses provided that its economic value is maintained. Deferred bonus compensation can be used to retain talented managers and encourage long-term strategic innovation. In addition, when bonuses are distributed over time, management's investment decisions are matched with the firm's long-term interest (Cheng et al. 2018). As deferred bonuses are converted from cash to equity, managers build up their shareholding in the firm over time, hence aligning their interest to those of the shareholders. On the other hand, deferred bonus payout may demotivate managers from engaging in risky innovation if they are not immediately rewarded for their effort. This is because individuals are present-biased (O'Donoghue and Rabin, 1999; Stevenson 1986; Rapoport and Yagil 1989) and view immediate payments to be more valuable than later payments. In addition, executives are motivated by immediate rewards for their effort as opposed to differed promises of future pay (Murphy and Jensen 2011). Survey evidence suggests that executives discount deferred pay by up to two-thirds, reiterating the notion that executives place lower value on long-term compensation, whereas immediate short-term rewards through bonus payments with certainty are preferred (PwC and London Business School, 2012). As a result, the value of deferred bonus payments may be discounted by

[5] Although the Australian Prudential Regulation Authority (APRA) has introduced prudential standards in relation to deferral and clawbacks for the banking, insurance and superannuation industries which will take effect in 2019 (APRA, 2019).

managers. This leads to the following non-directional hypothesis in relation to the deferral of the bonus:

H3: There is an association between bonus deferral and corporate innovation.

3. Research Design

3.1 Corporate Innovation

We measure firm innovation in two ways. The first measure is patent applications filed by firms (*Patent*). Since R&D investment may take time to result in patents, we examine the number of patent applications in the next 1, 2 and 3 years. Our second measure of firm innovation is based on the number of product related announcements made by firms (*Product*). While patents may be criticised to only capture technological innovation and more relevant for R&D intensive firms, product announcements reflect significant product development that involves broader types of innovation applicable to all industry forms. Similar to patents, we also measure the number of product related announcements over the subsequent one to three years.

3.2 Bonus Incentive Plan Designs

Our initial focus is on the types of financial performance targets that are included in the CEOs' bonus contract. To test *H1*, we construct a variable named *CostShield* similar to Bloomfield et al. (2021) which measures the degree of cost shielding in the CEO's bonus plan by combining these four indicator variables. We set the categorical variable *CostShield* equal to 3 when a revenue performance target is used, 2 when an EBITDA performance target is used, 1 when an EBIT performance target is used, and 0 when a net profit performance target is used. It is worth noting that firms in our sample on average include 1.49 financial performance targets. Accordingly, in cases where firms have multiple financial performance targets, the variable *CostShield* takes the value of the measure that is the most protective from cost (e.g., revenue performance target is the most cost shielding). Overall, this categorical variable ranges from 0 to 3.

We are also interested in identifying whether non-financial performance targets are relevant to motivate innovation. Accordingly, to test *H2*, *RiskTarget* is an indicator variable taking the value of 1 if the CEO's bonus contract is tied towards achieving risk-taking non-financial performance metrics including those related to innovation, R&D, strategy and product development, 0 otherwise.

Finally, we direct focus on the deferral clause attached to the bonus contract. To test H3, Bonus payment deferral is measured in three ways. First, *DDeferred* is an indicator variable taking the value of 1 if a component of the bonus is deferred into equity, 0 otherwise.

%Deferred is a continuous variable which captures the percentage of bonus that is deferred to subsequent years. Finally, *YDeferred* captures the number of years over which the bonus is deferred.

3.3 Model Specification

We examine the association between each of the above bonus incentive design variables and firm innovation using the following model:

$$Patent_{it+\tau} \text{ or } Product_{it+\tau} = \alpha_0 + \alpha_1 BonusDesign_{it} + \alpha_{2-14} Controls_{it} + Year\ FE + Industry\ FE + \varepsilon_{it+\tau} \quad (\tau = 1, 2, 3) \quad (1)$$

where the dependent variable is alternatively measured based on the number of patent applications (*Patent*) and product related announcements (*Product*). The key independent variable, represented by *BonusDesign* in Equation (1), is respectively captured by the degree of cost shielding in bonus plans (*CostShield*) to test *H1*, reliance on risk taking non-financial performance target (*RiskTarget*) to test *H2* and bonus deferral variables (*DDeferred, %Deferral* or *YDeferred*) to test *H3*.

Consistent with prior studies (e.g. Bloomfield et al. 2021), our empirical model includes controls that capture the economic characteristics of the firm such as firm size measured as the natural logarithm of total assets (*Size*), annual stock return (*Return*), annual capital expenditures (*CAPEX*), analyst following (*Analyst following*), and industry patent intensity measured as the natural logarithm of the number of patent applications made in the industry that year (*Industry patent intensity*). We also control for firm life cycle by including four indicator variables that each capture whether the firm is in its growth, mature, shake-out or decline phase (*Growth, Mature, Shake-out, Decline*) (Dickinson 2011).[6] CEO tenure (*Tenure*), the CEO's total compensation measured as the natural logarithm of total ex ante compensation (*Compensation*) and the equity proportion of the CEO's ex ante compensation (*%LTI*) are also controlled for. Industry defined by GICS sectors and year fixed effects are included in the model.

3.4 Sample and data

We initially use Connect4 to identify CEOs of ASX500 firms over the sample period 2004-2018. These form the foundation of our study for which we then manually collect the performance targets and deferral conditions that make up the CEO's bonus contract from the firm's annual reports. Firm financial data is downloaded from MorningStar's Datanalysis.

[6] We follow Dickinson (2011) to create five variables that capture the different stages in a firm's life cycle (*Introduction, Growth, Mature, Shake-Out* and *Decline*). *Introduction* is not included in the model to avoid multicollinearity.

Analyst following data is obtained from the Refinitive Thomson Reuters database. Firm patent data is sourced from UTS Australian Listed Firms' Patent Database. Product related announcement data is accessed from S&P Capital IQ Database.

We start our sample with the top 500 firms listed on Australian Stock Exchange over the 2004-2018 period. We start at 2004 because we are unable to observe CEO characteristics prior to 2004. The sample ends in 2018 because there is a delay in the reporting practices of patent applications. We initially drop firms that do not disclose sufficient information in relation to their compensation arrangement with the CEO (1,573 firm-year observations). In other words, we do not know whether or not these firms provide a bonus to the CEO, nor which performance targets are used, if any. Next, we remove a number of firm-year observations where the CEO was replaced during the year (356 firm-year observations), as well as a limited number of firms where the CEO is paid by another firm (15 observations). Finally, we exclude firm-year observations where firm characteristics data is missing (484). This sample selection process is described in Table 1. Our final sample includes 1,318 firm-year observations.

4. Empirical results and discussions

4.1 Descriptive statistics

Table 3 presents the descriptive statistics for all main variables used in this study. First, the average *Patent* is 0.262. In its natural form, this translates to an average of 0.875 number of patent applications (not tabulated).[7] For comparative purposes, the average for *Product* is 0.159, which in its natural form translates to an average of 0.490 with a maximum of 19 product announcements.

Figure 1 presents a visual representation as to how remuneration practices have changed in Australia over our sample period. The combination of fixed salary and bonus was a dominating choice prior to 2011, after which a combination of fixed salary, bonus as well as equity pay increased in popularity.[8] A possible explanation for this trend is the introduction of Say-on-pay in 2011. Figure 2 shows compensation practices vary substantially between industries. Within the group of firms that offer only fixed compensation, it is firms operating in the Materials sector that dominate. A possible explanation is that many of these firms are still at the exploration stage and consequently do not offer an incentive compensation

[7] It is also worth noting that at least one patent was applied for in approximately 19 percent of firm-year observations but that some firms apply for as many as 72 patents in one year (not tabulated).

[8] Consistent with prior studies, untabulated results indicate that almost all firms provide a bonus incentive to the CEO (93 percent), but a significant proportion do not receive any equity pay (25 percent).

component, in particular not one tied to equity. Overall, Figure 2 highlights the importance of controlling for industry fixed effects in our models.

On average, 62.9 percent of total compensation is variable (*Incentive Compensation)*. Results indicates that Australian CEOs are typically eligible for a substantial bonus, which amounts to 99.3 percent relative to their fixed salary (*%Bonus (over fixed)*). This corresponds to 37.3 percent of their total compensation (*%Bonus*). Long-term incentive pay (*%LTI*) represents a smaller proportion of total pay, accounting for 25.6 percent of total compensation for firms in our sample – this is visualised in Figure 3. Figure 4 demonstrates that these proportions changed ex-post, highlighting that bonus pay represents the greatest incentive compensation component when it comes to realised pay. There is considerable variation in how firms structure the matrix of performance metrics included in their bonus contract. On average, financial performance measures account for 22.7 percent of total compensation (*%Bonus_Fin*) (corresponding to 60 percent of the bonus) and non-financial performance measures (*%Bonus_NonFin*) account for 14.6 percent of total compensation (corresponding to 40 percent of the bonus). 38.5 percent of firms incorporate non-financial performance metrics that incentivize innovation (*RiskTarget*). The descriptive statistics on the firm characteristics reported in Table 3 are consistent with prior studies (e.g., Bachmann et al. 2020).

To the best of our knowledge, we are the first to provide detailed descriptive evidence on the extent to which firms incorporate deferral clauses in the CEO's bonuses in the Australian setting. Interestingly, Table 3 highlights that 33.9 percent of firms have a bonus deferral clause (*DDeferred*). On average, these firms defer around 40 percent of the bonus incentive pay (11 percent when including firms that do not have a deferral clause, as highlighted in Table 3) into equity-based pay (e.g., "deferred performance share rights")[9], which corresponds to AUD663,573 for the average CEO. For firms that defer bonus payments, the bonus payment is most commonly deferred for 2 years (not tabulated), but some firms defer for up to 5 years. This emphasises that while bonuses incentive plans are commonly viewed as short-term incentives, certain companies extend this time horizon for bonuses.

The average *CostShield* is 0.207 as illustrated in Table 3.[10] Figure 5 provides an overview of how the four financial performance targets can be combined. Here, it can be seen that 55 percent of firm-year observations include profit as a financial performance target on its

[9] See for example, Challenger Ltd. Page 23 of their 2018 annual report indicate that "at least 50% of bonus awards are deferred into Deferred Performance Share Rights (RPSRs), with vesting in equal tranches over two years."
[10] Untabulated results indicate that revenue performance targets are the least frequently utilised financial performance metric, representing only 6.8 percent of observations, while profit performance target is the most commonly used financial performance metric, constituting 66.5 percent of observations.

own, followed by EBIT and EBITDA as common individual performance targets. Interestingly, although revenue targets are the least frequently used financial performance target in our sample period, Figure 5 illustrates that it is most frequently used in conjunction with a profit target (2 percent) rather than on its own (1 percent). Other popular combinations include EBITDA and profit (5 percent) as well as EBIT and profit (3 percent). Figure 6 provides a visual representation for how firms combine revenue targets (the most cost shielding), profit targets (the least cost shielding) and non-financial performance targets. It also shows that many firms combine profit with non-financial performance targets (25 percent). As firms may incorporate a number of different financial performance targets in the CEO bonus contract simultaneously, we additionally explore the pairwise correlations between these performance targets (not tabulated).[11] As expected, firms are unlikely to include EBIT and EBITDA at the same time (-0.041†). Interestingly, profit as a financial target and *RiskTarget* have a moderate positive correlation (0.217†). A possible explanation may be that firms are aware that the inclusion of a performance target focusing on profit does not shield CEOs from innovation related costs and may disincentivize corporate investment. As a result, these firms may use non-financial performance targets to compliment profit targets.

Within the LTI component, market-related performance measures account for the greatest proportion (%*LTI_Market*). They account for 12.5 percent of total compensation (which corresponds to 51 percent of the LTI). The most common metric is adjusted TSR (*LTI_ATSR*), a metric which is included in 43.1 percent of firm-year observations. Some firms also included non-financial performance metrics within the LTI component, and 2.7 percent of firm-year observations included non-financial performance metrics specifically related to risk-taking.

Table 4 presents the pairwise correlations of the key variables included in this study. A positive correlation can be observed between *CostShield* and *Patent* (0.112). *RiskTarget* and *Patent* similarly display a positive correction (0.068) – providing initial support to *H1* and *H2*.

4.2 Main empirical results

Table 5 presents our main empirical results where we examine the association between CEO financial performance targets and patent application. We initially focus on patent applications for firm *t* in year *t+1,* as illustrated in columns (1) to (6) of Panel A. Column (3)

[11] On average, firms in our sample include 1.49 financial performance targets with the maximum being six financial performance targets used simultaneously.

demonstrates that bonus compensation (*%Bonus*) as well as equity compensation (*%LTI*) have a positive impact on patent application. A test of differences indicates that the coefficient on *%Bonus* and *%LTI* reported in column (3) are statistically different (*F-stat=16.53****). Consistent with *H1*, we find a positive association between financial performance metrics that are more cost shielding and long-term corporate investment, as represented by the number of patent applications (*Patent*). Specifically, *CostShield* is positive and significant *(β=0.073, p<0.01*) in column (5), corroborating that cost shielding incentivises investments in corporate innovation with this finding persisting over three years. This result is deemed to be of economic significance, as the number of patent applications made in year *t+1* increases by 1 for each one unit increase in *CostShield*. Similar results are presented in column (6) when the continuous variable *Costshield* is separated into *More CostShield* and *Less CostShield* with the results being significant only for firms that use *More CostShield* in their financial targets in bonus contracts. In other words, firms that incorporate EBITDA (revenue) targets are two (three) times more likely to make at least one patent application in the following year.

A number of control variables are consistently significant in Table 5. For example, as expected, a positive and significant association can be observed between firm size (*Size*) and *Patent* across all columns. Similarly, it is to be expected that great capital expenditure (*CAPEX*) and industry patent intensity (*Industry Patent Intensity*) are also positively associated with *Patent*. Consistent with prior literature (e.g., Bedford et al. 2023) we also observe a positive and significant association between equity-based pay (%*LTI*) and patent application.

[Insert Table 5 about here]

Next, we examine the impact of non-financial performance targets (*RiskTarget*) on corporate innovation. Consistent with our expectation, we find a positive and significant association between the use of non-financial performance targets in bonus plans (*RiskTarget*) and *Patent*. This result suggests that firms strategically use non-financial targets that provide direct reward for CEOs' risk-taking initiatives, to motivate innovation. The result is consistent across periods *t+1, t+2* and *t+3*. We consider this to be of economic significance as firms who incorporate such non-financial performance targets are 100 percent more likely to have a patent application in the three subsequent years. Consistent with Table 5, we find also find that firm size (Size), capital expenditures (CAPEX) and equity-based pay (*%LTI*) are positively associated with future patent application.

Table 6 presents the results where we examine the association between CEO bonus deferral and patent application. We measure bonus deferral in a number of ways, and overall, the results support our expectation that the value of deferred bonus payments may be discounted by managers. For example, we find a negative and significant association between *DDeferred* and Patent across all three periods. We also find that *%Deferred* and *YDeferred* are negatively associated with Patent. This result is of economic significance as for each additional deferral year, the number of patent applications decreases by one. As identified previously, factors such as firm size (*Size*) and capital expenditures (*CAPEX*) have a positive impact on patent application.

[Insert Table 6 about here]

5. Additional Analyses

5.1 Substitution or Complementary Effect?

Overall, our analyses support our contention that short-term bonus incentive plans are required to motivate innovation. Next, we examine whether both bonus incentive plans (%*Bonus*) and long-term incentive plans (%*LTI*) are required for innovative outcomes. Specifically, we examine whether bonus incentive plans and long-term incentive plans have complementary effects on innovation (i.e., the benefit of using long-term incentive plans increases with the use of bonus incentive plans and vice versa). In other words, without adequate bonus incentives, long-term incentive plans might not provide sufficient incentives to innovate and vice versa.

On the contrary, assuming that contracting using bonus incentive plans and long-term incentive plans are costly to firms, it is possible that firms favor one incentive compensation plan over the other. Hence, bonus incentive plans can act as an alternative to long-term incentive plan in our research setting whereby bonus incentive plans are more commonly used than equity-based compensation. In other words, we determine whether there is a substitution effect between CEO bonus and long-term incentive compensation when it comes to firm innovation.

We estimate the following ordinary least squares (OLS) model to examine whether *%Bonus* and *%LTI* are complementary or substitutes:

$$Patent_{it+\tau} = \beta_0 + \beta_1 \%Bonus_{it} + \beta_2 \%LTI_{it} + \beta_3 \%Bonus_{it} \times \%LTI_{it} + \beta_{4-11} Controls + Year\ FE + Industry\ FE + \varepsilon_{it+\tau}, (\tau = 1, 2, 3) \quad (2)$$

We are specifically interested in the interaction variable *%Bonus×%LTI*. Bonus incentive plans and equity incentive plans are complements if the benefit of one incentive plans on

corporate innovation increases with the use of the other. In this instance we expect a positive coefficient on β_3. Alternatively, if the use of bonus incentive plans and equity incentive plans are substitutes, the benefit of one incentive plans on corporate innovation decreases with the use of the other (Grabner and Moers 2013). Hence, we expect a negative coefficient on β_3.

The results are presented in Table 13. We find a positive association between %*Bonus* and corporate innovation (*Patent*) in column (1). Similarly, positive association can be observed between the use of equity incentive plans (*%*) and corporate innovation (*Patent*). The coefficient on the interaction *%Bonus*×*%LTI* is positive and significant. This positive coefficient suggests that bonus incentive plans and equity incentive plans are complements, as the benefit of one incentive plans on corporate innovation increases with the increasing use of the other. This result persists over time in the years *t+2* and *t+3* (untabulated).

In column (2) we examine which component of the bonus plan, financial or non-financial performance targets and which component of LTI, financial or market measures are driving the complementarity effect documented in column (1). We find that the combined use of financial targets in bonus contracts and the use of market-based measures in LTI (*%Bonus_Fin x %LTI_Market*) explain the results. In column (3) we further split financial performance targets into high cost shielding versus low-cost shielding and non-financial targets into risk taking non-financial targets versus non-risk taking non-financial targets. We find that that having both a risk taking non-financial performance target in bonus plans and market-based measures in LTI (*RiskTarget x %LTI_Market*) have a substitutive effect as both measures are forward looking.

[Insert Table 7 about here]

5.2 Endogeneity

5.2.1 Instrumental variable approach

There is a concern that bonus incentive plans are endogenous, influenced by unobservable factors that simultaneously affect firm innovation outcomes. To mitigate this concern, we employ an instrumental variable approach to separate the exogenous component of bonus incentive plan designs from the endogenous component. We develop the instrumental variables based on prior research evidence that firms' CEO compensation plans are formulated with references to the compensation arrangement of peer firms. CEO bonus plan designs of peer firms are reasonably expected to only correlate with the focal firm's CEO compensation, but

not correlate with the focal firm's future innovation performance. In this analysis, we define peer firms as those operating in the same GICS sector and in the same size quantile based on total assets. For a focal firm, the instrumental variable is calculated as the average value of the relevant bonus contract design variable from all peer firms. Then, we repeat our main analysis with the dependent variable being *Patent* and with each of the key independent variables being instrumented using peer firms' values.

Our initial focus is on *CostShield,* and accordingly, the instrumental variable is determined based on the average of *CostShield* for peer firms by industry and firm size. As indicated in Table 8, we report tests of both underidentification and weak identification and are able to reject the null in both cases.[12] Column (1) of Table 8 present results for the first stage, where a positive and significant coefficient on *CostShield_IV* can be observed. Columns (2), (3) and (4) present results for the second stage, which remain consistent with those presented in Table 5.

[Insert Table 8 about here]

Using the same approach, we also determine the average of *RiskTarget*, results of which are presented in Column (5) and where a positive and significant association can be observed on our instrumental variable (*RiskTarget_IV*). As before, we report tests of both underidentification and weak identification, and can reject the null hypothesis in both cases. Columns (6), (7) and (8) presented results for the second stage. These results are consistent with those previously reported in Table 5 and again indicate that firms strategically use non-financial targets to motivate innovation.

Results using an instrumental variable approach presented in Table 9 similarly confirm our main findings on bonus deferral, as originally reported in Table 7. As expected, our instrumental variable based on the deferral practices of peer firms (*DDeferred_IV, %Deferred_IV, YDeferred_IV*) are positive and significant in Columns (1), (5) and (7). Beyond this, the F-statistic presented in Column (1), (5) and (7) are all greater than the required critical value of 16.38.

5.3 Product Announcements

Our main results focus on patent application as a measure of corporate innovation. To further test the generalisability of our main empirical findings, we use an alternative measure to capture corporate innovation, namely product announcement. *Product* is measured as the

[12] For example, the weak identification test reports an F-statistic which is greater than the required Stock-Yogo critical value of 16.38.

natural logarithm of a firm's product announcements during the year. We obtain this data from the S&P Capital IQ. First, it is worth noting that firms in our sample on average make 0.490 product announcements during the year. A majority of firms make no product announcements, but some make up to 19 product announcements during the year. Consistent with our main empirical results, we consider product announcements in year *t+1, t+2* and *t*+3, results of which are presented in Table 12.

[Insert Table 9 about here]

5.4 Alternative sample selection

As illustrated in Panel B of Table 2, a large proportion of firms in our sample operate in the materials industry. Although this is a typical characteristic of the Australian setting, it means that many of these firms are unlikely to be at a stage where they are generating revenues. Hence, this will impact on the measurement of cost shield and/or higher reliance on non-financial performance targets. Accordingly, we conduct a number of additional tests where we exclude all firm-year observations that have 0 revenue during the year. Overall, our results remain consistent with those presented as the main empirical findings in this study (not tabulated).

6. Conclusion

This study examines whether bonus incentive plans can be designed to motivate long-term investment decisions, specifically corporate innovation. We argue and find that this can be achieved through (1) financial performance targets that excludes innovation related costs; (2) forward-looking non-financial performance targets that incentivises risk-taking; and (3) immediate bonus payments rather than deferrals.

Findings from this study have important practical implications for companies, shareholders and board of directors. Bonus plans have been criticised to encourage myopic and short-sighted managerial decisions and actions. Hence, equity-based and deferred executive compensations are commonly argued to serve the best long-term interest of shareholders. This study brings attention to the long-term performance implications of bonus plans and provides an alternative compensation solution for shareholders and board of directors to promote risky-taking activities that are oriented towards long-term value-creation.

This research also cautions against regulatory interventions on executive compensation contract designs observed in various national jurisdictions following the global financial crisis. For example, the European Parliament released directive 2010/76/EU which recommended a deferral of bonus payments over a period of years to avoid excessive risk taking by banking

executives. Based on this study's findings, such bonus deferrals may limit firms' innovativeness and damage long-term firm value.

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TABLES

Table 1: Sample selection

	N
Connect4 CEO data (2004-2018)	3,746
Less: Observations that do not disclose information on compensation in their annual reports	(1,573)
Less: Observations where the CEO was replaced during the year	(356)
Less: Observations where the CEO is paid from another firm	(15)
Less: Observations where required data on firm characteristics is not available in DatAnalysis	(484)
Final sample	**1,318**

Table 2: Sample distribution

Panel A: Distribution by year

Year	***N***	**%**	**%Patent**
2004	15	0.011	0.267
2005	27	0.020	0.259
2006	26	0.020	0.154
2007	29	0.022	0.310
2008	34	0.026	0.235
2009	42	0.032	0.190
2010	40	0.030	0.125
2011	70	0.053	0.214
2012	91	0.069	0.198
2013	101	0.077	0.248
2014	108	0.082	0.130
2015	147	0.112	0.143
2016	187	0.142	0.107
2017	191	0.145	0.126
2018	210	0.159	0.148
Total	1,318	1.000	0.162

Panel B: Distribution by industry

GICS Sector	***N***	**%**	**%Patent**
Communication Service	62	0.047	0.065
Consumer Discretionary	161	0.122	0.106
Consumer Staples	89	0.068	0.146
Energy	96	0.073	0.094
Financials	169	0.128	0.065
Health Care	86	0.065	0.291
Industrials	132	0.100	0.174
Information Technology	84	0.064	0.060
Materials	285	0.216	0.365
Real Estate	110	0.083	0.000
Utilities	44	0.033	0.0455
Total	1,318	1.000	0.162

Table 3: Descriptive statistics

Variables	N	Mean	Std. Dev.	Min	P25	P50	P75	Max
Patent (t+1)	1,318	0.262	0.618	0.000	0.000	0.000	0.000	4.078
Product (t+1)	1,318	0.159	0.505	0.000	0.000	0.000	0.000	2.485
Total Compensation	1,318	14.274	1.063	4.710	13.637	14.319	15.074	16.094
Incentive Compensation	1,318	0.629	0.169	0.000	0.495	0.600	0.677	0.932
%Bonus (over fixed)	1,318	0.993	0.599	0.000	0.522	1.000	1.200	6.900
%Bonus	1,318	0.373	0.137	0.000	0.281	0.361	0.444	0.836
%Bonus_NonFin	1,318	0.146	0.104	0.000	0.067	0.129	0.200	0.617
RiskTarget	1,318	0.385	0.487	0.000	0.000	0.000	1.000	1.000
No_RiskTarget	1,318	0.065	0.247	0.000	0.000	0.000	0.000	1.000
%Bonus_Fin	1,318	0.227	0.130	0.000	0.148	0.218	0.300	0.765
CostShield	1,318	0.207	0.759	0.000	0.000	0.000	3.000	3.000
More_CostShield	1,318	0.326	0.469	0.000	0.000	0.000	1.000	1.000
Less_CostShield	1,318	0.252	0.435	0.000	0.000	0.000	1.000	1.000
%LTI (over fixed)	1,318	0.756	0.640	0.000	0.300	0.730	1.000	3.545
%LTI	1,318	0.256	0.168	0.000	0.000	0.231	0.333	0.736
%LTI_Fin	1,318	0.092	0.110	0.000	0.000	0.060	0.165	0.632
LTI_More CostShield	1,318	0.357	0.479	0.000	0.000	0.000	1.000	1.000
LTI_Less CostShield	1,318	0.024	0.152	0.000	0.000	0.000	0.000	1.000
%LTI_Market	1,318	0.125	0.128	0.000	0.000	0.134	0.214	0.736
LTI_TSR	1,318	0.202	0.402	0.000	0.000	0.000	0.000	1.000
LTI_ATSR	1,318	0.431	0.496	0.000	0.000	0.000	1.000	1.000
%LTI_NonFin	1,318	0.039	0.165	0.000	0.000	0.000	0.000	0.300
LTI_RiskTarget	1,318	0.027	0.163	0.000	0.000	0.000	0.000	1.000
LTI_noRiskTarget	1,318	0.051	0.221	0.000	0.000	0.000	0.000	1.000
Deferred	1,318	0.339	0.474	0.000	0.000	0.000	1.000	1.000
%Deferred	1,318	0.118	0.207	0.000	0.000	0.000	0.300	1.000
YDeferred	1,318	0.572	0.915	0.000	0.000	0.000	1.000	5.000
Tenure	1,318	5.409	4.980	1.000	2.000	4.000	7.000	35.000
Return	1,318	0.139	0.502	-0.768	-0.134	0.073	0.296	2.521
Size	1,318	21.010	1.900	16.476	19.905	21.015	22.049	27.393
CAPEX	1,318	-0.055	0.074	-0.395	-0.065	-0.032	-0.010	0.000
Analyst following	1,318	6.669	5.513	0.000	2.000	7.000	12.000	17.000
Industry patent intensity	1,318	546.027	655.209	0.000	59.000	357.000	1398.000	2184.000
Introduction	1,318	0.064	0.245	0.000	0.000	0.000	0.000	1.000
Growth	1,318	0.268	0.443	0.000	0.000	0.000	1.000	1.000

Mature	1,318	0.536	0.499	0.000	0.000	1.000	1.000	1.000
Shake-out	1,318	0.105	0.306	0.000	0.000	0.000	0.000	1.000
Decline	1,318	0.027	0.163	0.000	0.000	0.000	0.000	1.000

This table presents the descriptive statistics of all main variables used in this paper. In order to address potential outliers that may significantly affect the statistical analysis, all continuous variables have been winsorized at the top and bottom 1 percent. All variables are defined in Appendix A.

Table 4: Correlation matrix

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1.	1.000															
2.	0.508*	1.000														
3.	0.153*	0.076*	1.000													
4.	0.136*	0.064^	0.743*	1.000												
5.	0.054*	0.076*	0.456*	0.617*	1.000											
6.	0.038^	-0.032	0.268*	0.263*	0.107*	1.000										
7.	0.050*	-0.008	0.266*	0.280*	0.126*	0.884*	1.000									
8.	0.115*	0.001	0.462*	0.618*	-0.237*	0.217*	0.221*	1.000								
9.	0.013	0.048†	0.230*	0.256*	0.466*	0.131*	0.129*	-0.130*	1.000							
10.	0.079*	0.043†	0.176*	0.219*	0.706*	-0.005	0.033	-0.362*	-0.300*	1.000						
11.	0.052†	-0.120*	0.275*	0.359*	-0.141*	0.126*	0.150*	0.466*	-0.087*	-0.071^	1.000					
12.	0.039	0.010	0.311*	0.488*	-0.246*	0.096*	0.104*	0.675*	0.079^	-0.261*	-0.231*	1.000				
13.	0.028†	0.000	0.108*	0.078*	-0.119*	0.015	-0.004	0.219*	-0.040	-0.166*	-0.160*	-0.115*	1.000			
14.	0.112*	0.083*	0.070*	0.088*	0.093*	-0.040	-0.024	0.015	-0.156*	0.221*	0.138*	-0.061†	0.000	1.000		
15.	0.068*	0.042†	0.305*	0.235*	0.024	0.216*	0.209*	0.264*	0.165*	-0.173*	0.035	0.236*	0.069*	-0.086*	1.000	
16.	-0.081*	-0.048^	-0.473*	-0.312*	-0.084*	-0.362*	-0.345*	-0.301*	0.078*	-0.026	-0.093*	-0.143*	-0.094*	-0.246*	-0.646*	1.000
17.	0.097*	-0.037	0.360*	0.359*	-0.032†	0.198*	0.221*	0.475*	-0.110*	-0.067*	0.624*	-0.357*	0.010	0.101*	0.184*	-0.265*
18.	0.008	-0.038	0.067*	0.066*	-0.043^	0.040*	0.016	0.125*	-0.074*	-0.014	0.188*	-0.112*	0.018	0.092*	0.047*	-0.068*
19.	0.046*	-0.109*	0.311*	0.309*	-0.095*	0.120*	0.111*	0.477*	0.033	-0.214*	-0.079*	0.286*	0.095*	0.002	0.290*	-0.150*
20.	0.091*	0.215*	0.118*	0.202*	0.080*	0.240*	0.267*	0.140*	0.031	0.050	-0.058^	0.248*	-0.108*	0.028	-0.019	-0.329*
21.	0.045*	0.030	0.080*	0.067*	-0.057*	0.057*	0.030^	0.139*	0.035	-0.115*	-0.050†	-0.024	0.347*	-0.101*	0.081*	-0.073*
22.	0.002	-0.026	0.115*	0.087*	-0.115*	0.032^	0.025†	0.226*	-0.054^	-0.144*	-0.106*	-0.043	0.760*	0.010	0.060*	-0.086*
23.	-0.027	-0.029	-0.062*	-0.139*	-0.120*	-0.027	-0.027	-0.048^	-0.110*	0.034	-0.020	-0.041	-0.005	0.048	-0.023	0.036^
24.	0.183*	0.109*	0.325*	0.526*	0.377*	0.281*	0.293*	0.266*	0.326*	0.090*	0.139*	0.270*	0.025	-0.105*	0.153*	-0.228*
25.	0.022	0.010	0.039^	0.117*	0.129*	0.032^	0.029†	0.015	0.012	0.117*	0.136*	-0.095*	-0.006	0.040	0.028†	-0.038^
26.	0.151*	0.111*	0.201*	0.305*	0.208*	0.169*	0.191*	0.169*	0.219*	0.068*	0.127*	0.151*	-0.011	0.007	0.048*	-0.089*
27.	0.221*	0.304*	-0.011	-0.111*	-0.202*	-0.009	0.004	0.065*	-0.089*	-0.092*	-0.056^	0.014	0.060*	0.047†	-0.003	0.027†
28.	0.025†	-0.010	-0.014	-0.022	0.007	-0.053*	-0.042*	-0.034†	0.018	-0.048†	0.012	-0.089*	0.018	-0.025	-0.012	0.004
29.	-0.053*	-0.004	-0.001	0.013	0.011	-0.002	-0.011	0.005	0.036	-0.044†	-0.018	0.012	-0.002	-0.027	0.012	-0.007
30.	0.068*	0.020	0.130*	0.106*	0.062*	0.042*	0.048*	0.069*	-0.089*	0.094*	0.086*	-0.050†	-0.001	0.105*	0.034^	-0.080*
31.	-0.009	-0.013	0.008	0.039^	0.036†	0.052*	0.042*	0.013	0.026	0.019	-0.006	0.049†	-0.011	-0.001	-0.005	0.016
32.	0.004	-0.028	-0.074*	-0.056*	-0.059*	-0.011	-0.004	-0.011	-0.004	-0.022	-0.046†	0.060^	-0.006	-0.066^	-0.019	0.034^

	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.
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18.	0.084*	1.000														
19.	0.336*	0.050*	1.000													
20.	-0.022	-0.030	-0.581*	1.000												
21.	0.058*	0.051*	0.138*	-0.059^	1.000											
22.	0.059*	0.007	0.118*	-0.045†	-0.018	1.000										
23.	-0.037^	-0.003	-0.025	-0.098*	-0.002	-0.009	1.000									
24.	0.197*	0.008	0.165*	0.213*	0.045*	0.046*	-0.119*	1.000								
25.	0.033^	0.005	0.016	-0.046†	-0.009	-0.003	-0.001	0.139*	1.000							
26.	0.131*	0.011	0.094*	0.129*	0.012	-0.005	-0.052*	0.582*	0.031^	1.000						
27.	0.003	-0.034^	0.002	0.074*	0.031^	0.049*	0.032†	-0.144*	-0.045*	-0.005	1.000					
28.	-0.001	-0.034^	-0.014	-0.060^	-0.008	0.007	-0.030†	0.004	-0.034^	-0.028†	0.000	1.000				
29.	0.019	-0.013	-0.007	0.059^	-0.015	-0.009	0.004	0.121*	0.000	0.039^	-0.034^	-0.008	1.000			
30.	0.102*	0.049*	0.059*	-0.040	0.022	0.016	-0.058*	0.072*	0.038^	0.122*	0.002	0.083*	-0.558*	1.000		
31.	-0.005	-0.009	0.033^	0.010	-0.007	-0.010	-0.027	0.052*	-0.034^	-0.030†	-0.077*	0.001	-0.216*	-0.317*	1.000	
32.	-0.046*	-0.026†	-0.042*	0.010	-0.001	-0.007	0.061*	-0.052*	0.030†	-0.085*	-0.008	-0.036^	-0.123*	-0.181*	-0.070*	1.000

*This table presents the pairwise correlations for all key variables in this study. The variables included are as follows:1. Patent; 2. Product; 3. Total compensation; 4. Variable Compensation; 5. %Bonus; 6. %Deferred; 7. YDeferred; 8. %LTI; 9. %Bonus_NonFin; 10. %Bonus_Fin; 11. %LTI_Fin; 12. %LTI_Market; 13. %LTI_NonFin; 14. CostShield; 15. RiskTarget; 16. No_RiskTarget; 17. LTI_MoreCostShield; 18. LTI_LessCostShield; 19. LTI_TSR; 20. LTI_ATSR; 21. LTI_RiskTarget: 22. LTI_NoRiskTarget; 23. Return; 24. Size; 25. CAPEX; 26. Analyst Following; 27. Industry Intensity; 28. Tenure; 29. Growth; 30. Mature; 31. Shake-out; 32. Decline.† p<0.01, ^ p<0.05, * p<0.1*

Table 5: OLS estimation: association between CEO's bonus compensation and innovation

Panel A: The association between CEO's bonus compensation and patent application in year t+1

Variables	(1)	(2)	(3)	(4)	(5)	(6)
			Patent (t+1)			
Total Compensation	**0.010****					
	(2.327)					
%Incentive Compensation		**0.346*****				
		(5.542)				
%Bonus			**0.250*****			
			(4.727)			
%Bonus_NonFin				0.261		
				(0.970)		
RiskTarget					**0.099****	**0.091****
					(2.017)	**(2.553)**
No_RiskTarget					0.066	0.005
					(0.691)	(0.084)
%Bonus_Fin				**0.608*****		
				(4.088)		
CostShield					**0.073*****	
					(4.357)	
More CostShield						**0.215*****
						(3.604)
Less CostShield						-0.033
						(-0.683)
%LTI			**0.464*****			
			(4.571)			
%LTI_Fin				0.356	0.116	
				(1.316)	(0.535)	
LTI More CostShield						-0.034
						(-0.681)
LTI Less CostShield						-0.002
						(-0.026)
%LTI_Market				**0.578***	**0.336***	
				(2.028)	**(1.690)**	
LTI_TSR						-0.010
						(-0.325)
LTI_ATSR						**0.101*****
						(3.079)
%LTI_NonFin				0.033	-0.039	
				(0.486)	(-0.319)	
LTI_RiskTaking						**0.320*****
						(4.324)
LTI_no RiskTaking						-0.097
						(-1.764)
Return	-0.001	-0.005	-0.005	-0.002	-0.011	-0.013
	(-0.480)	(-0.801)	(-0.768)	(-0.044)	(-0.298)	(-0.337)
Size	0.045**	0.039***	0.041***	0.039***	0.057***	0.055***
	(2.233)	(5.639)	(6.010)	(5.081)	(3.617)	(6.370)
CAPEX	0.002	0.156*	0.162*	0.887***	0.675**	0.755***
	(0.120)	(1.828)	(1.859)	(4.873)	(2.503)	(5.205)
Analyst following	0.001	0.003	0.002	0.001	-0.001	0.001
	(0.362)	(1.043)	(0.810)	(0.296)	(-0.131)	(0.237)
Industry patent intensity	0.000***	0.000***	0.000***	0.001***	0.000***	0.000***
	(9.298)	(6.163)	(5.942)	(10.302)	(12.153)	(7.559)
Tenure	0.006*	0.009***	0.009***	0.009**	0.006	0.007**
	(2.008)	(6.640)	(6.934)	(2.238)	(1.396)	(2.390)
Growth	-0.051	-0.102**	-0.106**	-0.064	-0.072	-0.031
	(-0.659)	(-2.258)	(-2.278)	(-0.830)	(-0.707)	(-0.476)
Mature	-0.016	-0.066	-0.069	-0.084	-0.074	-0.013
	(-0.184)	(-1.652)	(-1.701)	(-1.409)	(-0.758)	(-0.298)
Shake-out	-0.003	-0.009	-0.014	0.032	-0.015	0.020
	(-0.054)	(-0.172)	(-0.284)	(0.395)	(-0.130)	(0.272)
Decline	0.087*	0.127**	0.119**	-0.104	-0.133	-0.019
	(1.903)	(2.546)	(2.399)	(-0.867)	(-0.761)	(-0.184)
Constant	-0.993**	-0.936***	-1.839***	-1.095***	-1.290***	-1.239***
	(-2.236)	(-7.653)	(-6.983)	(-4.919)	(-3.911)	(-6.024)
N	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*
Year Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Adj. R-squared	*0.176*	*0.213*	*0.215*	*0.249*	*0.251*	*0.271*

This table presents results for Model (1) where the dependent variable is *Patent (t+1)*. The key independent variables to test *H1* is the degree to which firms use cost shield financial performance targets in bonus contracts (*CostShield*). *CostShield* is measured as a categorical variable equal to 3 when a revenue target is used, 2 when an EBITDA target is used, 1 when an EBIT target is used, and 0 for all remaining performance metrics, including when a profit target is included. In cases where firms have multiple financial performance targets, the variable takes the value of the measure that is the most protective from cost. The key independent variable to test *H2* is the degree to which firms explicitly encourage firms to undertake more risks (*RiskTarget). RiskTarget* is an indicator variable taking the value of 1 if the CEO's bonus performance targets include non-financial performance targets related to risk-taking (e.g., words such as R&D strategy, develop, new product, innovation), 0 otherwise. All other variables are defined in Appendix A. All continuous variables are winsorized at the top and bottom 1 percent. ∗, ∗∗, and ∗∗∗ represent significance at the 10%, 5%, and 1% levels, respectively.

Panel B: The association between the CEO's bonus compensation and patent application in years t+2 and year t+3

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	***Patent (t+2)***						***Patent (t+3)***					
Total Compensation	**0.010*** **						**0.008*** **					
	(7.423)						**(10.520)**					
%Incentive Compensation		**0.334*** **						**0.392*** **				
		(4.915)						**(7.721)**				
%Bonus			**0.228*** **						**0.292*** **			
			(4.133)						**(4.939)**			
%Bonus_NonFin				0.370						0.393		
				(1.569)						(1.564)		
RiskTarget					**0.107** **	**0.084***					**0.088***	**0.087** **
					(2.262)	**(2.071)**					**(1.848)**	**(2.186)**
No_RiskTarget					0.063	-0.004					0.013	-0.038
					(0.681)	(-0.058)					(0.137)	(-0.757)
%Bonus_Fin				**0.680*** **						**0.555** **		
				(4.098)						**(3.021)**		
CostShield					**0.071*** **						**0.057*** **	
					(4.382)						**(3.514)**	
More CostShield						**0.171*** **						**0.163*** **
						(3.677)						**(3.236)**
Less CostShield						-0.064						-0.091*
						(-1.485)						(-2.055)
%LTI			**0.464*** **						**0.515*** **			
			(4.483)						**(5.971)**			
%LTI_Fin				0.301	0.049					**0.239***	0.011	
				(1.753)	(0.236)					**(2.055)**	(0.055)	
LTI More CostShield						-0.034						-0.063
						(-0.815)						(-1.532)
LTI Less CostShield						-0.073						-0.051
						(-1.218)						(-0.609)
%LTI_Market				**0.688** **	**0.402** **					**0.697*** **	**0.395** **	
				(2.913)	**(2.067)**					**(3.871)**	**(2.030)**	
LTI_Market												
LTI_TSR						0.012						0.020
						(0.164)						(0.551)
LTI_ATSR						**0.100*** **						**0.102*** **
						(3.607)						**(3.868)**
%LTI_nonFin				0.043	-0.421					0.059	-0.342	
				(0.437)	(-1.008)					(0.603)	(-0.815)	
LTI_nonFin_Risk						**0.244** **						**0.272** **
						(2.458)						**(2.365)**
LTI_nonFin_other						-0.103						-0.109
						(-1.518)						(-1.456)
Return	-0.001	-0.005	-0.005	-0.032	-0.042	-0.047	-0.002	-0.002	-0.002	0.001	-0.005	-0.017

	(-0.669)	(-1.286)	(-1.271)	(-0.830)	(-1.125)	(-1.343)	(-1.168)	(-0.516)	(-0.508)	(0.032)	(-0.142)	(-0.518)
Size	0.041***	0.036***	0.038***	0.035**	0.053***	0.050***	0.041***	0.032***	0.033***	0.041**	0.055***	0.049***
	(7.347)	(5.186)	(5.444)	(2.311)	(3.449)	(3.778)	(8.319)	(6.543)	(7.055)	(2.904)	(3.562)	(4.292)
CAPEX	0.004	0.132	0.139	0.874***	0.732***	0.768***	-0.000	0.094	0.101	0.675*	0.558**	0.648**
	(0.221)	(1.618)	(1.675)	(5.286)	(2.806)	(5.403)	(-0.022)	(1.236)	(1.292)	(2.104)	(2.134)	(2.782)
Analyst following	0.002	0.004	0.003	0.002	-0.001	0.001	0.002	0.004	0.003	0.000	-0.001	0.001
	(1.218)	(1.653)	(1.351)	(0.322)	(-0.140)	(0.213)	(1.265)	(1.471)	(1.297)	(0.090)	(-0.204)	(0.298)
Industry patent intensity	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000**	0.000***	0.000***	0.000***
	(4.084)	(3.324)	(3.206)	(3.493)	(12.248)	(8.007)	(3.871)	(3.126)	(2.999)	(3.177)	(11.512)	(7.638)
Tenure	0.005***	0.008***	0.008***	0.011**	0.009**	0.009**	0.005***	0.006***	0.006***	0.004	0.002	0.003
	(3.655)	(4.786)	(4.900)	(3.003)	(1.970)	(2.500)	(3.358)	(3.172)	(3.282)	(0.889)	(0.377)	(0.956)
Growth	-0.039	-0.101***	-0.105***	-0.027	-0.054	-0.011	-0.050	-0.094*	-0.098*	-0.043	-0.067	-0.022
	(-1.323)	(-3.079)	(-3.133)	(-0.439)	(-0.550)	(-0.336)	(-1.481)	(-2.042)	(-2.069)	(-0.565)	(-0.684)	(-0.435)
Mature	-0.025	-0.074*	-0.077*	-0.055	-0.059	0.007	-0.026	-0.076	-0.079*	-0.064	-0.067	0.002
	(-0.883)	(-1.895)	(-2.010)	(-0.705)	(-0.617)	(0.127)	(-0.895)	(-1.747)	(-1.794)	(-0.960)	(-0.709)	(0.056)
Shake-out	-0.004	-0.053	-0.060	0.053	-0.009	0.042	-0.030	-0.064	-0.070*	0.072	0.017	0.060
	(-0.136)	(-1.279)	(-1.439)	(0.658)	(-0.081)	(0.675)	(-1.159)	(-1.673)	(-1.844)	(0.758)	(0.154)	(0.843)
Decline	0.079	0.080	0.071	-0.050	-0.101	0.042	0.067**	0.007	-0.001	-0.193	-0.227	-0.036
	(1.596)	(1.042)	(0.914)	(-0.268)	(-0.599)	(0.274)	(2.286)	(0.124)	(-0.015)	(-1.745)	(-1.337)	(-0.356)
Constant	-0.900***	-0.847***	-0.846***	-1.031***	-1.226***	-1.129***	-0.853***	-0.743***	-0.741***	-1.048***	-1.198***	-1.067***
	(-7.284)	(-5.737)	(-5.802)	(-3.263)	(-3.835)	(-4.526)	(-7.547)	(-5.992)	(-5.957)	(-3.382)	(-3.738)	(-4.171)
N	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*
Year controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Adj. R-squared	*0.175*	*0.208*	*0.211*	*0.259*	*0.260*	*0.257*	*0.172*	*0.188*	*0.190*	*0.219*	*0.219*	*0.248*

This table presents results for Model (1) where the dependent variable is *Patent (t+2)* in columns (1) to (6) and *Patent (t+3)* in columns (7) to (12). The key independent variables to test *H1* is the degree to which firms use cost shield financial performance targets in bonus contracts (*CostShield*). *CostShield* is measured as a categorical variable equal to 3 when a revenue target is used, 2 when an EBITDA target is used, 1 when an EBIT target is used, and 0 for all remaining performance metrics, including when a profit target is included. In cases where firms have multiple financial performance targets, the variable takes the value of the measure that is the most protective from cost. The key independent variable to test *H2* is the degree to which firms explicitly encourage firms to undertake more risks (*RiskTarget). RiskTarget* is an indicator variable taking the value of 1 if the CEO's bonus performance targets include non-financial performance targets related to risk-taking (e.g., words such as R&D strategy, develop, new product, innovation), 0 otherwise. All other variables are defined in Appendix A. All continuous variables are winsorized at the top and bottom 1 percent. ∗, ∗∗, and ∗∗∗ represent significance at the 10%, 5%, and 1% levels, respectively.

Table 6: OLS estimation: association between CEO's bonus deferral and future patent applications.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables		***Patent (t+1)***			***Patent (t+2)***			***Patent (t+3)***	
DDeferred	**-0.095***			**-0.092***			**-0.099****		
	(-1.927)			**(-1.886)**			**(-2.146)**		
%Deferred		**-0.317****			**-0.312****			**-0.253****	
		(-3.024)			**(-3.020)**			**(-2.969)**	
YDeferred			**-0.056****			**-0.054****			**-0.057****
			(-2.126)			**(-2.107)**			**(-2.287)**
Return	0.048	0.019	0.019	-0.007	-0.017	-0.017	0.020	0.019	0.022
	(1.048)	(0.322)	(0.503)	(-0.154)	(-0.381)	(-0.466)	(0.489)	(0.433)	(0.530)
Size	0.060***	0.066***	0.061***	0.064***	0.070***	0.066***	0.054***	0.067***	0.055***
	(3.303)	(6.175)	(3.258)	(3.539)	(3.981)	(3.566)	(3.405)	(6.619)	(3.439)
CAPEX	1.123***	0.939***	1.110***	1.155***	0.984***	1.138***	0.541*	0.789**	0.538*
	(3.452)	(4.665)	(3.355)	(3.587)	(5.265)	(3.484)	(1.866)	(2.521)	(1.839)
Analyst following	-0.003	-0.004	-0.002	-0.002	-0.003	-0.002	-0.005	-0.003	-0.005
	(-0.525)	(-0.723)	(-0.395)	(-0.373)	(-0.687)	(-0.318)	(-1.114)	(-0.776)	(-1.053)
Industry patent intensity	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.000***	0.000***	0.000***
	(4.312)	(8.288)	(4.199)	(3.703)	(5.125)	(3.656)	(12.377)	(4.963)	(12.276)
Compensation	0.016	0.014*	0.018	0.013	0.011	0.014	0.018*	0.014**	0.020*
	(1.290)	(1.968)	(1.388)	(1.012)	(1.189)	(1.136)	(1.655)	(2.233)	(1.762)
Tenure	-0.005	0.003	-0.013	-0.032	-0.023	-0.038	-0.056	-0.019	-0.061
	(-0.054)	(0.037)	(-0.129)	(-0.319)	(-0.385)	(-0.382)	(-0.609)	(-0.206)	(-0.656)
%LTI	0.010	0.024	0.007	-0.024	-0.011	-0.025	-0.014	-0.010	-0.016
	(0.104)	(0.388)	(0.072)	(-0.249)	(-0.144)	(-0.261)	(-0.158)	(-0.139)	(-0.175)
Growth	0.110	0.131*	0.128	0.084	0.105	0.104	0.012	0.109	0.023
	(0.978)	(1.836)	(1.118)	(0.756)	(1.376)	(0.919)	(0.110)	(0.999)	(0.219)
Mature	0.000	0.016	0.008	-0.052	-0.032	-0.037	-0.183	-0.128	-0.181
	(0.001)	(0.109)	(0.048)	(-0.334)	(-0.218)	(-0.235)	(-1.256)	(-1.132)	(-1.233)
Shake-out	0.008*	0.008*	0.009*	0.009**	0.008	0.009**	0.001	0.003	0.001
	(1.777)	(1.970)	(1.811)	(1.980)	(1.773)	(1.978)	(0.193)	(0.614)	(0.222)
Decline	0.079**	0.076***	0.077*	0.071*	0.067	0.070*	0.088**	0.054***	0.090***
	(2.059)	(3.102)	(1.945)	(1.851)	(1.542)	(1.790)	(2.582)	(4.367)	(2.600)
Constant	-1.427***	-1.542***	-1.454***	-1.568***	-1.692***	-1.626***	-1.275***	-1.653***	-1.326***
	(-3.506)	(-6.092)	(-3.494)	(-3.892)	(-5.194)	(-3.957)	(-3.918)	(-7.721)	(-3.980)
N	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*
Year controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Adj. R-squared	*0.294*	*0.296*	*0.292*	*0.278*	*0.282*	*0.280*	*0.191*	*0.255*	*0.193*

This table presents results for Model (1) where the dependent variable is *Patent (t+1)* in columns (1) to (3), *Patent (t+2)* in columns (4) to (6) and *Patent (t+3)* in columns (7) to (9). The key independent variables are bonus payment deferrals (*DDeferred, %Deferred* and *YDeferred)*. *DDeferred* is an indicator variable taking the value of 1 if the firm deferred a proportion of the CEO's bonus to a subsequent period, 0 otherwise. *%Deferred* is the proportion of bonus that is deferred to a subsequent period. This is a continuous variable that ranges from 0 to 1. *YDeferred* is the number of years the bonus is deferred. This variable takes a value of zero if the bonus is not deferred. All other variables are defined in Appendix A. All continuous variables are winsorized at the top and bottom 1 percent. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

Table 7: OLS estimation: the substitution effect between the CEO's bonus and long-term incentive compensation on future patent applications

Variables	(1)	(2)	(3)	(4)
		Patent (t+1)		
%Bonus	**0.194*** **			
	(3.295)			
%LTI	0.021			
	(0.123)			
%Bonus x %LTI	**1.610** **			
	(2.211)			
%Bonus_NonFin		0.458		
		(1.453)		
RiskTarget			**0.258*** **	**0.124*** **
			(2.678)	**(5.203)**
Non_RiskTarget			0.076	0.013
			(0.761)	(0.187)
%Bonus_Fin		**0.399***		
		(1.979)		
CostShield			**0.078** **	
			(2.476)	
More CostShield				**0.173*** **
				(3.192)
Less CostShield				-0.032
				(-0.711)
%LTI_Fin		0.351	0.063	
		(1.296)	(0.289)	
LTI_More CostShield				-0.028
				(-0.590)
LTI_Less CostShield				0.030
				(0.391)
%LTI_Market		-0.205	**0.730** **	
		(-0.478)	**(2.145)**	
LTI_TSR				-0.018
				(-0.421)
LTI_ ATSR				**0.115***
				(1.959)
%LTI_NonFin		0.048	-0.223	
		(0.688)	(-0.511)	
LTI_RiskTarget				-0.207
				(-1.642)
LTI_NonRiskTarget				**-0.096***
				(-1.825)
%Bonus_Fin x %LTI_Market		**4.420** **		
		(2.194)		
RiskTarget x CostShield			-0.065	
			(-1.256)	
CostShield x %LTI_Market			-0.119	
			(-0.619)	
RiskTarget x %LTI_Market			-1.226**	
			(-2.529)	
***Risk Taking x** CostShield x %LTI_Market*			**0.574** **	
			(1.983)	
More_CostShiled x LTI_ATSR				-0.040
				(-0.494)
RiskTarget x LTI_ATSR				-0.173**
				(-2.535)
More Costshield x RiskTarget x LTI_ATSR				0.529*
				(2.084)
More CostShield x LTI_RiskTarget				-0.592*
				(-2.134)
RiskTarget x LTI_RiskTarget				0.722**
				(2.627)
LTI_ATSR x LTI_RiskTarget				0.934***
				(4.190)
RiskTarget x LTI_ATSR x LTI_RiskTarget				-1.552***
				(-4.395)
Return	-0.005	-0.001	-0.008	-0.011
	(-0.804)	(-0.032)	(-0.197)	(-0.316)
Size	0.037***	0.025*	0.056***	0.052***
	(5.271)	(2.169)	(3.510)	(5.667)
CAPEX	0.173*	0.870***	0.669**	0.742***
	(1.958)	(5.053)	(2.477)	(6.071)
Analyst following	0.002	0.001	0.000	-0.000

	(0.694)	(0.368)	(0.080)	(-0.001)
Industry patent intensity	0.000***	0.001***	0.000***	0.000***
	(5.834)	(9.272)	(11.583)	(6.525)
Tenure	0.010***	0.008**	0.006	0.007**
	(6.882)	(2.361)	(1.203)	(2.247)
Growth	-0.105**	-0.075	-0.088	-0.027
	(-2.300)	(-0.963)	(-0.870)	(-0.530)
Mature	-0.069	-0.085	-0.082	-0.003
	(-1.729)	(-1.345)	(-0.838)	(-0.075)
Shake-out	-0.019	0.017	-0.036	0.029
	(-0.391)	(0.197)	(-0.319)	(0.432)
Decline	0.125**	-0.148	-0.179	-0.048
	(2.524)	(-1.084)	(-1.022)	(-0.443)
Constant	-0.841***	-0.755**	-1.273***	-1.158***
	(-6.509)	(-2.437)	(-3.772)	(-5.233)
N	*1,318*	*1,318*	*1,318*	*1,318*
Year controls	*Yes*	*Yes*	*Yes*	*Yes*
Industry controls	*Yes*	*Yes*	*Yes*	*Yes*
Adj. R-squared	*0.218*	*0.257*	*0.256*	*0.295*

This table presents results for Model (2) where the dependent variable is *Patent,* measured at *t+1*. *%Bonus* is the maximum ex ante proportion of bonus divided by total compensation. *%LTI* is the maximum ex ante proportion of long-term incentive compensation divided by total compensation. Our variable of interest is the interaction between *%Bonus* and *%LTI*, *%Bonus x %LTI.* A positive (negative) coefficient on *%Bonus x %LTI* indicates that *%Bonus* and *%LTI* are complementary (substitutes). We further disaggregate *%Bonus* and *%LTI* into their various components in columns (2) to (4) to understand which component of *%Bonus* and *%LTI* the results are attributable to. All other variables are defined in Appendix A. All continuous variables are winsorized at the top and bottom 1 percent. ∗, ∗∗, and ∗∗∗ represent significance at the 10%, 5%, and 1% levels, respectively.

Table 8: Instrumental variable approach - association between CEO compensation and future patent applications

Panel A: Instrumental variable approach - association between the CEO's performance targets and future patent applications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Stage 1		**Stage 2**		**Stage 1**		**Stage 2**	
Variables	***CostShield***	***Patent(t+1)***	***Patent(t+2)***	***Patent(t+3)***	***RiskTaking***	***Patent(t+1)***	***Patent(t+2)***	***Patent(t+3)***
CostShield_IV	0.775***							
	(9.872)							
CostShield		**0.126*** **	**0.124*** **	**0.154*** **				
		(3.315)	**(3.302)**	**(3.994)**				
RiskTaking_IV					0.521*			
					(1.915)			
RiskTarget	-0.216*	**0.128** **	**0.126** **	**0.142*** **		**1.426** **	**1.277***	**1.475***
	(-1.899)	**(2.513)**	**(2.396)**	**(2.661)**		**(2.042)**	**(1.825)**	**(1.883)**
No_RiskTarget	-1.184***	0.112	0.124	0.148	-0.331***	0.436	0.391	0.427
	(-9.821)	(1.084)	(1.352)	(1.607)	(-8.009)	(1.602)	(1.507)	(1.411)
More_CostShield					-0.131**	**0.353** **	**0.288** **	**0.302** **
					(-2.512)	**(2.562)**	**(2.436)**	**(2.252)**
Less_CostShield					-0.064	0.010	-0.034	-0.053
					(-1.301)	(0.141)	(-0.620)	(-0.695)
LTI_More CostShield	0.027	-0.045	-0.050	-0.091**	-0.074**	0.059	0.048	0.020
	(0.263)	(-1.010)	(-1.118)	(-2.024)	(-2.098)	(0.752)	(0.679)	(0.219)
LTI_Less CostShiled	0.227	-0.029	-0.097	-0.083	0.050	-0.099	-0.157*	-0.150
	(0.871)	(-0.390)	(-1.630)	(-1.140)	(0.784)	(-1.168)	(-1.840)	(-1.593)
LTI_TSR	0.076	-0.010	0.012	0.010	0.181***	**-0.327** **	**-0.277***	**-0.294***
	(0.325)	(-0.117)	(0.145)	(0.122)	(3.245)	**(-2.079)**	**(-1.878)**	**(-1.936)**
LTI_ATSR	**0.255** **	**0.105** **	**0.096***	**0.099***	0.194***	-0.192	-0.164	-0.186
	(2.217)	**(2.065)**	**(1.856)**	**(1.960)**	(6.135)	(-1.176)	(-1.075)	(-1.132)
LTI_RiskTarget	-0.634**	**0.374***	**0.309***	**0.376** **	-0.034	**0.361** **	**0.285** **	**0.323***
	(-2.540)	**(1.885)**	**(1.756)**	**(1.998)**	(-0.241)	**(1.963)**	**(2.061)**	**(1.838)**
LTI_NoRiskTarget	0.235	**-0.139** **	**-0.135***	**-0.159** **	-0.032	-0.087	-0.090	-0.080
	(1.187)	**(-1.980)**	**(-1.720)**	**(-2.204)**	(-0.854)	(-1.073)	(-0.932)	(-0.749)
Return	0.169**	-0.024	-0.067*	-0.038	0.031**	-0.054	-0.084*	-0.059
	(2.364)	(-0.672)	(-1.907)	(-1.003)	(2.174)	(-1.386)	(-1.934)	(-1.301)
Size	-0.063*	0.068***	0.064***	0.068***	0.005	0.037**	0.037**	0.036*
	(-1.820)	(4.386)	(4.096)	(4.318)	(0.416)	(2.528)	(1.986)	(1.662)
CAPEX	0.739*	0.640***	0.636***	0.476*	0.309	0.432	0.472	0.208
	(1.656)	(2.850)	(3.184)	(1.668)	(1.128)	(0.828)	(1.124)	(0.348)
Analyst following	0.019*	0.000	0.000	-0.000	-0.007***	0.012*	0.011	0.012**
	(1.843)	(0.079)	(0.053)	(-0.017)	(-2.723)	(1.718)	(1.432)	(2.527)
Industry patent intensity	0.000	0.000***	0.000***	0.000***	0.000	0.000*	0.000	0.000
	(1.435)	(9.508)	(8.959)	(8.940)	(0.902)	(1.875)	(1.166)	(0.724)
Tenure	-0.014	0.008*	0.010**	0.004	-0.001	0.013**	0.014**	0.009
	(-1.424)	(1.875)	(2.205)	(0.887)	(-0.456)	(2.314)	(2.161)	(1.356)
Growth	0.397**	-0.031	-0.014	-0.030	0.015	-0.057	-0.018	-0.020
	(2.094)	(-0.389)	(-0.169)	(-0.344)	(0.189)	(-0.500)	(-0.155)	(-0.182)
Mature	0.314*	-0.027	-0.008	-0.029	0.044	-0.077	-0.039	-0.039

	(1.766)	(-0.342)	(-0.097)	(-0.343)	(0.692)	(-0.884)	(-0.329)	(-0.450)
Shake-out	0.447*	0.019	0.041	0.044	-0.037	0.099	0.136	0.169
	(1.937)	(0.219)	(0.431)	(0.445)	(-0.389)	(0.736)	(1.079)	(1.159)
Decline	0.330	-0.008	0.059	-0.032	-0.173	0.227	0.279	0.235
	(1.154)	(-0.069)	(0.408)	(-0.210)	(-1.123)	(1.156)	(1.361)	(0.940)
Constant	0.718	-1.388***	-1.705***	-1.782***	0.156	-1.153**	-1.538***	-1.550***
	(0.973)	(-4.167)	(-5.260)	(-5.362)	(0.723)	(-2.488)	(-3.348)	(-3.339)
Observations	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*
Year Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Kleibergen-Paap rk LM statistic	*69.08***				*57.02***			
Cragg-Donald Wald F statistic	*86.05*				*74.13*			

This table presents results for the instrumental variable analysis of the association between CEO performance targets and future patent applications. Column (1) present results for Stage 1, whereas all other columns present results for Stage 2. All variables are defined in Appendix A. The Kleibergen-Paap rk LM statistic is used as an underidentification test whereas the Cragg-Donald Wald F statistic is used as a weak identification test. All continuous variables are winsorized at the top and bottom 1 percent. ∗, ∗∗, and ∗∗∗ represent significance at the 10%, 5%, and 1% levels, respectively.

Panel B: Instrumental variable approach - association between CEO bonus deferral and future patent applications

Variables	(1) Stage 1 *DDeferred*	(2) *Patent (t+1)*	(3) Stage 2 *Patent (t+2)*	(4) *Patent (t+3)*	(5) Stage 1 *%Deferred*	(6) Stage 2 *Patent (t+1)*	(7) Stage 1 *YDeferred*	(8) Stage 2 *Patent (t+1)*
DDeferred_IV	**1.181*** **							
	(6.437)							
%Deferred_IV					**1.303*** **			
					(6.382)			
YDeferred_IV							**1.242*** **	
							(6.052)	
DDeferred		**-0.747*** **	**-0.732*** **	**-0.517** **				
		(-2.874)	**(-2.829)**	**(-2.058)**				
%Deferred						**-1.891*** **		
						(-3.619)		
YDeferred								-0.369***
								(-2.858)
Return	0.022	0.045	0.020	0.037	0.011	0.049	0.033	0.045
	(1.288)	(1.329)	(0.645)	(1.209)	(1.309)	(1.393)	(1.032)	(1.345)
Size	0.048***	0.114***	0.117***	0.091***	0.018***	0.119***	0.081***	0.110***
	(4.351)	(3.879)	(4.131)	(3.324)	(3.340)	(4.431)	(3.223)	(3.907)
CAPEX	-0.071	0.184	0.189	0.185	0.009	0.257	-0.183	0.170
	(-1.026)	(1.085)	(1.095)	(1.179)	(0.217)	(1.273)	(-1.214)	(1.103)
Analyst following	0.001	-0.004	-0.006	-0.005	0.001	-0.003	0.006	-0.002
	(0.496)	(-0.778)	(-1.253)	(-1.241)	(0.761)	(-0.627)	(1.073)	(-0.335)
Industry patent intensity	-0.000	0.000***	0.000***	0.000***	-0.000	0.000***	-0.000	0.000***
	(-0.059)	(9.607)	(9.329)	(9.524)	(-0.725)	(9.209)	(-0.568)	(9.317)
Compensation	-0.003	0.008*	0.009	0.011**	-0.001	0.007	-0.000	0.011**
	(-0.691)	(1.669)	(1.608)	(2.528)	(-0.661)	(1.395)	(-0.034)	(2.394)
Tenure	0.116***	0.084	0.050	0.028	0.036**	0.073	0.126	0.027
	(3.047)	(1.103)	(0.640)	(0.356)	(2.066)	(1.005)	(1.582)	(0.387)
%LTI	0.121***	0.153**	0.123*	0.093	0.042***	0.146**	0.156**	0.103
	(3.619)	(2.101)	(1.655)	(1.238)	(2.641)	(2.072)	(2.172)	(1.549)
Growth	0.171***	0.196**	0.155*	0.122	0.085***	0.240**	0.343***	0.192**
	(3.457)	(2.159)	(1.655)	(1.332)	(3.322)	(2.513)	(3.048)	(2.083)
Mature	0.116*	0.096	0.067	0.010	0.046	0.100	0.230	0.085
	(1.747)	(0.944)	(0.658)	(0.105)	(1.463)	(0.941)	(1.524)	(0.813)
Shake-out	-0.010***	-0.004	-0.004	-0.005	-0.004***	-0.005	-0.016***	-0.002
	(-4.505)	(-0.991)	(-0.937)	(-1.169)	(-4.190)	(-1.054)	(-3.876)	(-0.572)
Decline	-0.009	0.093**	0.079**	0.081**	-0.013	0.077**	-0.047	0.085**
	(-0.399)	(2.560)	(2.190)	(2.467)	(-1.271)	(2.033)	(-1.097)	(2.342)
Constant	-1.185***	-2.845***	-2.835***	-2.295***	-0.446***	-2.925***	-2.091***	-2.791***
	(-5.692)	(-4.501)	(-4.615)	(-3.875)	(-4.543)	(-5.092)	(-4.472)	(-4.563)
N	*1,126*	*1,126*	*1,126*	*1,126*	*1,112*	*1,126*	*1,126*	*1,112*
Year controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Kleibergen-Paap rk LM	*37.864****				*39.101****		*40.040****	

statistic				
Cragg-Donald Wald F statistic	*45.563*		*46.472*	*52.909*

This table presents results for the instrumental variable analysis of the association between CEO bonus payment deferrals and future patent applications. Column (1) and (5) present results for Stage 1, whereas all other columns present results for Stage 2. The Kleibergen-Paap rk LM statistic is used as an underidentification test whereas the Cragg-Donald Wald F statistic is used as a weak identification test. All variables are defined in Appendix A. All continuous variables are winsorized at the top and bottom 1 percent. ∗, ∗∗, and ∗∗∗ represent significance at the 10%, 5%, and 1% levels, respectively.

Table 9: OLS estimation: Association between the CEO's bonus compensation and product announcements

Panel A: The association between the CEO's bonus compensation and Product announcements in year t+1

	(1)	(2)	(3)	(4)	(5)	(6)
Variables			***Product(t+1)***			
Total Compensation	**0.012*** **					
	(4.028)					
%Incentive Compensation		**0.490*** **				
		(4.652)				
%Bonus			**0.588*** **			
			(5.746)			
%Bonus_NonFin				**0.565** **		
				(2.940)		
RiskTarget					**0.131*** **	**0.104** **
					(2.834)	**(2.240)**
No_RiskTarget					0.038	-0.006
					(0.419)	(-0.105)
%Bonus_Fin				**0.524*** **		
				(4.259)		
CostShield					**0.053*** **	
					(3.367)	
More CostShield						**0.136** **
						(2.238)
Less CostShield						**-0.094***
						(-2.076)
%LTI			**0.430*** **			
			(3.561)			
%LTI_Fin				0.246	-0.017	
				(0.882)	(-0.086)	
LTI More CostShield						-0.061
						(-1.048)
LTI Less CostShield						-0.008
						(-0.337)
%LTI_Market				**0.603** **	**0.303***	
				(2.333)	**(1.697)**	
LTI_Market						
LTI_TSR						-0.045
						(-0.607)
LTI_ATSR						**0.102** **
						(2.203)
%LTI_NonFin				0.030	-0.264	
				(0.313)	(-0.651)	
LTI_RiskTarget						**0.217***
						(2.109)
LTI_noRiskTarget						**-0.108***
						(-2.069)
Return	0.030	0.037	0.036	0.004	-0.008	-0.012
	(0.677)	(0.884)	(0.877)	(0.106)	(-0.233)	(-0.303)
Size	0.035**	0.015	0.014	0.019	0.039***	0.040***
	(2.455)	(1.482)	(1.346)	(1.514)	(2.588)	(3.628)
CAPEX	0.242	0.271	0.265	0.708**	0.526**	0.576***
	(1.222)	(1.245)	(1.224)	(2.913)	(2.072)	(3.595)
Analyst following	-0.001	0.001	0.001	0.002	0.002	0.001
	(-0.182)	(0.147)	(0.204)	(0.295)	(0.377)	(0.319)
Industry patent intensity	0.001***	0.001***	0.001***	0.001***	0.000***	0.000***
	(6.654)	(5.954)	(5.725)	(6.005)	(11.547)	(5.767)
Tenure	0.003	0.005	0.005	0.006	0.006	0.008*
	(0.976)	(1.224)	(1.234)	(1.418)	(1.278)	(2.058)
Growth	-0.065	-0.071	-0.069	-0.046	-0.063	-0.024
	(-0.951)	(-0.840)	(-0.833)	(-0.509)	(-0.661)	(-0.413)
Mature	-0.034	-0.048	-0.047	-0.059	-0.073	-0.020
	(-0.541)	(-0.585)	(-0.581)	(-0.689)	(-0.794)	(-0.365)
Shake-out	0.003	-0.007	-0.003	0.022	-0.011	0.020
	(0.040)	(-0.077)	(-0.031)	(0.262)	(-0.103)	(0.406)
Decline	0.028	-0.048	-0.044	-0.109	-0.132	0.023
	(0.348)	(-0.475)	(-0.453)	(-1.124)	(-0.802)	(0.213)
Constant	-0.995***	-0.678**	-0.675**	-0.797**	-0.950***	-0.925***
	(-3.119)	(-2.305)	(-2.321)	(-2.619)	(-3.060)	(-3.381)
N	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*

Year controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Adj. R-squared	*0.193*	*0.209*	*0.209*	*0.228*	*0.239*	*0.248*

This table presents results for Model (1) where the dependent variable is *Product (t+1)* measured as the natural log of 1 plus the number of product announcements made by the firm. The key independent variables to test *H1* is the degree to which firms use cost shield financial performance targets in bonus contracts (*CostShield*). *CostShield* is measured as a categorical variable equal to 3 when a revenue target is used, 2 when an EBITDA target is used, 1 when an EBIT target is used, and 0 for all remaining performance metrics, including when a profit target is included. In cases where firms have multiple financial performance targets, the variable takes the value of the measure that is the most protective from cost. The key independent variable to test *H2* is the degree to which firms explicitly encourage firms to undertake more risks (*RiskTarget). RiskTarget* is an indicator variable taking the value of 1 if the CEO's bonus performance targets include non-financial performance targets related to risk-taking (e.g., words such as R&D strategy, develop, new product, innovation), 0 otherwise. All other variables are defined in Appendix A. All continuous variables are winsorized at the top and bottom 1 percent. ∗, ∗∗, and ∗∗∗ represent significance at the 10%, 5%, and 1% levels, respectively.

Panel B: The association between the CEO's bonus compensation and Product announcements in years t+2 and t+3

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
				Product(t+2)						***Product(t+3)***		
Total Compensation	**0.011*** **						**0.009*** **					
	(5.011)						**(3.584)**					
%Incentive Compensation		**0.347*** **						**0.280** **				
		(3.343)						**(3.003)**				
%Bonus			**0.492*** **						**0.425*** **			
			(4.621)						**(3.699)**			
%Bonus_NonFin			**0.257** **						**0.190** **			
			(2.443)						**(2.259)**			
RiskTarget				**0.519** **						**0.470***		
				(2.195)						**(2.069)**		
No_RiskTarget					**0.119*** **	**0.090***					**0.108*** **	0.078
					(2.797)	**(2.025)**					**(2.759)**	(1.767)
%Bonus_Fin					0.070	0.011					0.053	-0.003
					(0.843)	(0.192)					(0.698)	(-0.044)
CostShield				**0.332** **						**0.337*** **		
				(2.496)						**(3.075)**		
More CostShield					**0.048*** **						**0.050*** **	
					(3.301)						**(3.785)**	
Less CostShield						**0.121***						**0.130** **
						(2.084)						**(2.632)**
%LTI						**-0.082***						-0.061
						(-1.792)						(-1.432)
%LTI_Fin				-0.060	-0.239					-0.066	-0.248	
				(-0.322)	(-1.277)					(-0.525)	(-1.447)	
LTI More CostShield						-0.084						**-0.097** **
						(-1.775)						**(-2.373)**
LTI Less CostShield						**-0.030** **						**-0.030** **
						(-2.404)						**(-2.199)**
%LTI_Market				0.423	0.193					**0.392***	0.170	
				(1.630)	(1.112)					**(2.147)**	(1.065)	
LTI_Market												
LTI_TSR						-0.062						-0.051
						(-1.142)						(-1.119)
LTI_ATSR						**0.096** **						**0.106*** **
						(2.402)						**(3.113)**
%LTI_NonFin				-0.043	-0.377					**-0.136*** **	**-0.565***	
				(-0.565)	(-1.007)					**(-3.097)**	**(-1.648)**	
LTI_RiskTarget						**0.147***						0.099
						(1.789)						(0.925)
LTI_noRiskTarget						**-0.093***						**-0.117*** **
						(-2.081)						**(-3.355)**
Return	-0.015	-0.014	-0.015	-0.016	-0.030	-0.025	-0.021	-0.026	-0.027	-0.027	-0.037	-0.027

	(-0.649)	(-0.586)	(-0.673)	(-0.494)	(-0.890)	(-0.865)	(-0.964)	(-1.128)	(-1.237)	(-0.928)	(-1.212)	(-1.001)
Size	0.015	0.002	-0.000	0.012	0.028**	0.029*	0.014	0.003	0.001	0.013	0.029**	0.028**
	(1.332)	(0.187)	(-0.031)	(0.935)	(2.065)	(2.178)	(1.364)	(0.335)	(0.093)	(0.995)	(2.270)	(2.282)
CAPEX	0.261	0.279	0.270	0.684***	0.525**	0.561***	0.186	0.205	0.197	0.534**	0.374*	0.429**
	(1.370)	(1.363)	(1.341)	(3.158)	(2.245)	(3.397)	(1.303)	(1.310)	(1.280)	(2.538)	(1.743)	(2.550)
Analyst following	0.003	0.004	0.004	0.005	0.004	0.004	0.002	0.003	0.003	0.002	0.002	0.002
	(1.121)	(1.188)	(1.273)	(0.943)	(1.065)	(1.361)	(0.837)	(0.820)	(0.902)	(0.459)	(0.580)	(0.846)
Industry patent intensity	0.000***	0.000***	0.000***	0.001***	0.000***	0.000***	0.000**	0.000**	0.000**	0.000**	0.000***	0.000***
	(5.674)	(5.381)	(5.130)	(4.874)	(9.861)	(4.401)	(2.720)	(2.413)	(2.279)	(2.296)	(8.450)	(3.704)
Tenure	-0.000	0.001	0.001	0.003	0.002	0.004	-0.003	-0.002	-0.002	-0.000	-0.000	0.001
	(-0.144)	(0.270)	(0.303)	(0.774)	(0.543)	(1.278)	(-1.274)	(-0.711)	(-0.658)	(-0.021)	(-0.129)	(0.209)
Growth	-0.086	-0.095	-0.092	-0.064	-0.084	-0.044	-0.057	-0.056	-0.052	-0.057	-0.078	-0.050
	(-1.191)	(-1.039)	(-1.025)	(-0.763)	(-0.958)	(-0.805)	(-1.061)	(-0.802)	(-0.758)	(-0.685)	(-0.972)	(-0.906)
Mature	-0.096	-0.107	-0.105	-0.109	-0.129	-0.072	-0.040	-0.038	-0.036	-0.054	-0.075	-0.030
	(-1.586)	(-1.278)	(-1.268)	(-1.358)	(-1.520)	(-1.486)	(-0.796)	(-0.548)	(-0.532)	(-0.664)	(-0.962)	(-0.612)
Shake-out	-0.023	-0.028	-0.022	0.007	-0.028	-0.002	0.003	0.005	0.011	-0.000	-0.032	-0.012
	(-0.292)	(-0.300)	(-0.235)	(0.097)	(-0.282)	(-0.041)	(0.038)	(0.057)	(0.137)	(-0.000)	(-0.353)	(-0.180)
Decline	-0.102*	-0.145*	-0.139*	-0.171*	-0.203	-0.118*	-0.074	-0.083	-0.076	-0.142	-0.166	-0.119
	(-2.150)	(-1.887)	(-1.930)	(-1.952)	(-1.336)	(-2.083)	(-1.522)	(-1.186)	(-1.172)	(-1.462)	(-1.196)	(-1.617)
Constant	-0.540*	-0.278	-0.272	-0.519	-0.644**	-0.618*	-0.442*	-0.239	-0.234	-0.458	-0.640**	-0.588*
	(-2.081)	(-1.047)	(-1.037)	(-1.504)	(-2.250)	(-1.993)	(-1.880)	(-1.019)	(-1.008)	(-1.354)	(-2.438)	(-2.071)
N	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*
Year controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Adj. R-squared	*0.171*	*0.180*	*0.182*	*0.198*	*0.213*	*0.218*	*0.150*	*0.159*	*0.162*	*0.173*	*0.194*	*0.205*

This table presents results for Model (1) where the dependent variable is *Product (t+2)* in columns (1) to (6) and *Product (t+3)* in columns (7) to (12). *Product* is the natural log of 1 plus the number of product announcements made by the firm. The key independent variables to test *H1* is the degree to which firms use cost shield financial performance targets in bonus contracts (*CostShield*). *CostShield* is measured as a categorical variable equal to 3 when a revenue target is used, 2 when an EBITDA target is used, 1 when an EBIT target is used, and 0 for all remaining performance metrics, including when a profit target is included. In cases where firms have multiple financial performance targets, the variable takes the value of the measure that is the most protective from cost. The key independent variable to test *H2* is the degree to which firms explicitly encourage firms to undertake more risks (*RiskTarget). RiskTarget* is an indicator variable taking the value of 1 if the CEO's bonus performance targets include non-financial performance targets related to risk-taking (e.g., words such as R&D strategy, develop, new product, innovation), 0 otherwise. All other variables are defined in Appendix A. All continuous variables are winsorized at the top and bottom 1 percent. ∗, ∗∗, and ∗∗∗ represent significance at the 10%, 5%, and 1% levels, respectively.

Panel C: OLS estimation: association between CEO bonus deferral and future product announcements

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Product (t+1)			***Product (t+2)***			***Product (t+3)***	
DDeferred	-0.084*			-0.083**			-0.070**		
	(-1.938)			(-2.117)			(-2.156)		
%Deferred		-0.235**			-0.219**			-0.171**	
		(-2.924)			(-2.842)			(-2.231)	
YDeferred			-0.048**			-0.043**			-0.046***
			(-2.061)			(-2.014)			(-2.632)
Return	0.003	0.004	-0.004	-0.031	-0.012	-0.011	-0.044	-0.031	-0.043
	(0.086)	(0.101)	(-0.105)	(-0.842)	(-0.408)	(-0.373)	(-1.513)	(-0.997)	(-1.465)
Size	0.039**	0.033**	0.040**	0.035**	0.031*	0.029*	0.025**	0.026	0.028**
	(2.558)	(2.443)	(2.561)	(2.542)	(2.047)	(1.945)	(2.304)	(1.709)	(2.490)
CAPEX	0.563**	0.801***	0.534*	0.513**	0.775***	0.899***	0.281	0.609**	0.269
	(2.027)	(3.496)	(1.899)	(2.040)	(3.337)	(3.355)	(1.381)	(2.687)	(1.308)
Analyst following	0.004	0.002	0.004	0.006*	0.004	0.005	0.006*	0.004	0.006*
	(0.829)	(0.425)	(0.938)	(1.659)	(1.174)	(1.291)	(1.839)	(1.152)	(1.904)
Industry patent intensity	0.000***	0.001***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000**	0.000***
	(11.586)	(6.625)	(11.421)	(9.668)	(5.928)	(3.638)	(9.603)	(2.922)	(9.572)
Compensation	0.009	0.014*	0.010	0.010	0.013**	0.016	0.005	0.012**	0.006
	(0.854)	(1.991)	(0.940)	(0.071)	(2.316)	(1.509)	(0.628)	(2.719)	(0.774)
Tenure	0.009	-0.014	0.002	-0.019	-0.057	-0.066	-0.034	-0.054	-0.036
	(0.102)	(-0.136)	(0.021)	(-0.239)	(-0.556)	(-0.813)	(-0.531)	(-0.596)	(-0.562)
%LTI	-0.011	-0.033	-0.018	-0.080	-0.105	-0.116	-0.039	-0.056	-0.040
	(-0.125)	(-0.364)	(-0.207)	(-1.021)	(-1.121)	(-1.467)	(-0.627)	(-0.644)	(-0.646)
Growth	0.046	0.045	0.053	0.007	-0.007	-0.008	-0.005	-0.005	0.002
	(0.449)	(0.498)	(0.507)	(0.080)	(-0.075)	(-0.090)	(-0.073)	(-0.052)	(0.027)
Mature	-0.021	-0.015	-0.013	-0.155	-0.166	-0.166	-0.088	-0.116	-0.083
	(-0.145)	(-0.129)	(-0.087)	(-1.200)	(-1.726)	(-1.281)	(-0.857)	(-1.150)	(-0.804)
Shake-out	0.007*	0.009	0.009**	0.001	0.001	0.002	-0.001	-0.000	-0.001
	(1.860)	(1.536)	(2.080)	(0.228)	(0.580)	(0.440)	(-0.273)	(-0.089)	(-0.243)
Decline	-0.004	0.017	-0.006	-0.064**	-0.040*	-0.044	-0.057**	-0.043**	-0.060**
	(-0.111)	(0.298)	(-0.179)	(-2.089)	(-1.942)	(-1.370)	(-2.385)	(-2.486)	(-2.458)
Constant	-0.973***	-0.801***	-1.011***	-0.742***	-0.614**	-0.596*	-0.537**	-0.507	-0.605***
	(-3.085)	(-3.272)	(-3.121)	(-2.598)	(-2.201)	(-1.766)	(-2.349)	(-1.712)	(-2.585)
N	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*
Year controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Adj. R-squared	*0.178*	*0.217*	*0.177*	*0.136*	*0.184*	*0.184*	*0.115*	*0.143*	*0.118*

This table presents results for Model (1) where *Product* is the dependent variable. In Panel A, *Product* is measured at *t+1*, and at *t+2* and *t+3* in Panel B. In Panel C, *Product* is measured at *t+1* in Column (1), at *t+2* in Column (2), and *t+3* in Column (3). The key independent variables are bonus payment deferrals (*DDeferred, %Deferred* and *YDeferred)*. *DDeferred* is an indicator variable taking the value of 1 if the firm deferred a proportion of the CEO's bonus to a subsequent period, 0 otherwise. *%Deferred* is the proportion of bonus that is deferred to a subsequent period. This is a continuous variable that ranges from 0 to 1. *YDeferred* is the number of years the bonus is deferred. This variable takes a value of zero if the bonus is not deferred. All other variables are defined in Appendix A. All continuous variables are winsorized at the top and bottom 1 percent. ∗, ∗∗, and ∗∗∗ represent significance at the 10%, 5%, and 1% levels, respectively.

APPENDICES

Appendix A: Variable definitions

Variables	Definition
Patent	The natural log of 1 plus the number of patents applications made by the firm.
Product	The natural log of 1 plus the number of product announcements made by the firm.
Compensation variables:	
Total Compensation	The natural log of the CEO's total ex ante compensation.
Incentive Compensation	The maximum ex ante proportion of incentive compensation (i.e. bonus and LTI) divided by total compensation.
%Bonus	The maximum ex ante proportion of bonus divided by total compensation.
%LTI	The maximum ex ante proportion of LTI divided by total compensation.
%Bonus_NonFin	The maximum ex ante proportion of compensation attributed to meeting non-financial performance targets.
%Bonus_Fin	The maximum ex ante proportion of compensation attributed to meeting non-financial performance targets.
%LTI_Fin	The maximum ex ante proportion of compensation attributed to meeting financial performance targets included in the LTI contract.
%LTI_Market	The maximum ex ante proportion of compensation attributed to meeting market-based performance targets included in the LTI contract.
%LTI_NonFin	The maximum ex ante proportion of compensation attributed to meeting non-financial performance targets included in the LTI contract.
CostShield	A categorical variable equal to 3 when a revenue target is used, 2 when an EBITDA target is used, 1 when an EBIT target is used, and 0 for all remaining performance metrics, including when a profit target is included. In cases where firms have multiple financial performance targets, the variable takes the value of the measure that is the most protective from cost.
RiskTarget	An indicator variable taking the value of 1 if the CEO's bonus performance targets include non-financial performance targets related to innovation (i.e. the performance targets mention words such as innovation, R&D, strategy, develop, new product), 0 otherwise
No_RiskTarget	An indicator variable taking the value of 1 if the CEO's bonus performance targets include non-financial performance targets but they are not related to innovation (i.e. the performance targets does not mention words such as innovation, R&D, strategy, develop, new product), 0 otherwise
More CostShield	An indicator variable taking the value of 1if *CostShield* is greater than 1, 0 otherwise.

Less CostShield	An indicator variable taking the value of 1 if *CostShield* is less than 1, 0 otherwise.
LTI_More CostShield	An indicator variable taking the value of 1if the financial performance measures included in the LTI component are linked to EBITDA or Revenue, 0 otherwise.
LTI_Less CostShield	An indicator variable taking the value of 1 if financial performance measures are included in the LTI components but they are not EBITDA or Revenue, 0 otherwise.
LTI_TSR	An indicator variable taking the value of 1 if the market measure included in the LTI component is total shareholder return, 0 otherwise.
LTI_ATSR	An indicator variable taking the value of 1 if the market measure included in the LTI component is an adjusted measure of total shareholder return, 0 otherwise.
LTI_RiskTarget	An indicator variable taking the value of 1 if the CEO's LTI performance targets include non-financial performance targets related to innovation (i.e. the performance targets mention words such as innovation, R&D, strategy, develop, new product), 0 otherwise
LTI_noRiskTarget	An indicator variable taking the value of 1 if the CEO's LTI performance targets include non-financial performance targets but they are not related to innovation (i.e. the performance targets does not mention words such as innovation, R&D, strategy, develop, new product), 0 otherwise
DDeferred	An indicator variable taking the value of 1 if the firm deferred a proportion of the CEO's bonus to a subsequent period, 0 otherwise. Firm-year observation in which no proportion of the CEOs bonus is deferred take a value of 0.
%Deferred	The proportion of bonus that is deferred to a subsequent period. This is a continuous variable which can range from 0 to 1.
YDeferred	The number of years the bonus is deferred. This variable takes the value 0 if the bonus is not deferred.
CostShield_IV	The average of *CostShield* of all peer firms from the same GICS sector and size quantile as the focal firm.
InnoTarget_IV	The average of *InnoTarget* of all peer firms from the same GICS sector and size quantile as the focal firm.
DDeferred_IV	The average of *DDeferred* of all peer firms from the same GICS sector and size quantile as the focal firm.
%Deferred_IV	The average of *%Deferred* of all peer firms from the same GICS sector and size quantile as the focal firm.
YDeferred_IV	The average of *YDeferred* of all peer firms from the same GICS sector and size quantile as the focal firm.
CEO controls	
Tenure	The number of years that have passed between the current year and the year in which the CEO was appointed.
Firm controls	
Return	Annual stock return.
Size	The natural log of total assets.

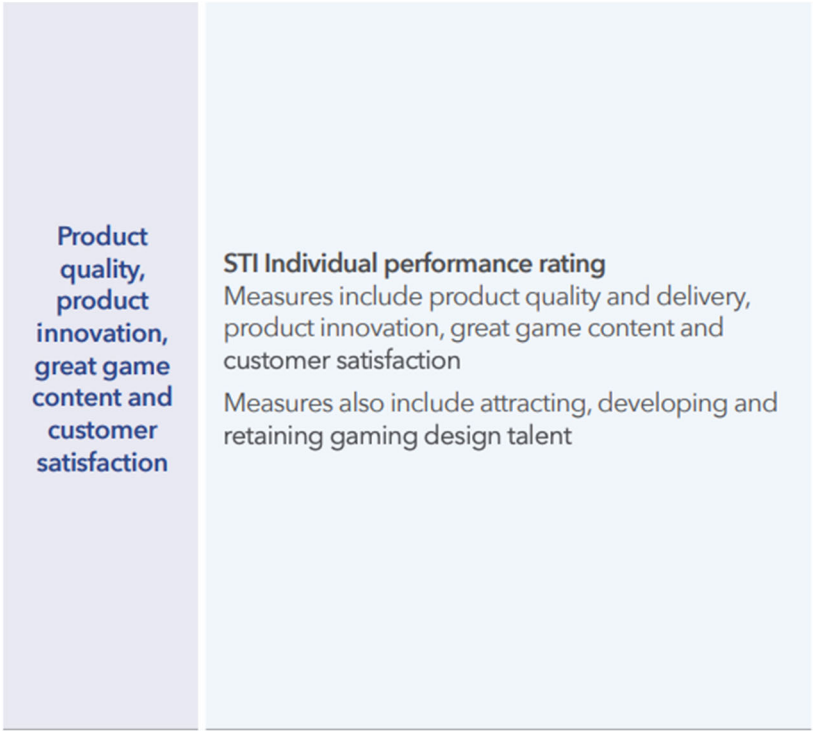
CAPEX	Annual capital expenditures scaled by total assets.
Analyst following	The number of financial analysts that follow the firm during the year.
Industry patent intensity	Total industry patent application in year.
Introduction	An indicator variable coded 1 if cash flow from operating activities is negative, cash flow from investing activities is negative and cash flow from financing activities is positive, 0 otherwise.
Growth	An indicator variable coded 1 if cash flow from operating activities is positive, cash flow from investing activities is negative and cash flow from financing activities is positive, 0 otherwise.
Mature	An indicator variable coded 1 if cash flow from operating activities is positive, cash flow from investing activities is negative and cash flow from financing activities is negative, 0 otherwise.
Shake-out	An indicator variable coded 1 if cash flow from operating activities, cash flow from investing and cash flow from financing activities are either all negative or all positive; or if cash flow from operating activities is positive, cash flow from investing activities is positive and cash flow from financing activities is negative, 0 otherwise.
Decline	An indicator variable coded 1 if cash flow from operating activities is negative, cash flow from investing activities is positive and cash flow from financing activities is positive; or if cash flow from operating activities is negative, cash flow from investing activities is positive and cash flow from financing activities is negative, 0 otherwise.

Appendix B: Examples of non-financial targets used in bonus incentive plans

Challenger Annual Report 2018, p. 34:

	Measures	Outcomes	Results
Weighting : 10% (continued)	**Product** Successful diversification into new product areas arising from regulatory change and innovation	Deferred Lifetime Annuities (DLAs) launched for the Australian market. The successful sale of DLAs awaits commencement of the new means test rules in July 2019. Continued focus on the Japanese annuity market has seen the generation of $0.6 billion of sales via the reinsurance relationship with MS Primary in 2018 and the introduction of a new lifetime product. Funds Management has commenced development of a new active Exchange Traded Fund product category that is expected to launch in the first half of 2019.	

Aristocrat Leisure Limited Annual Report 2018, p. 42:



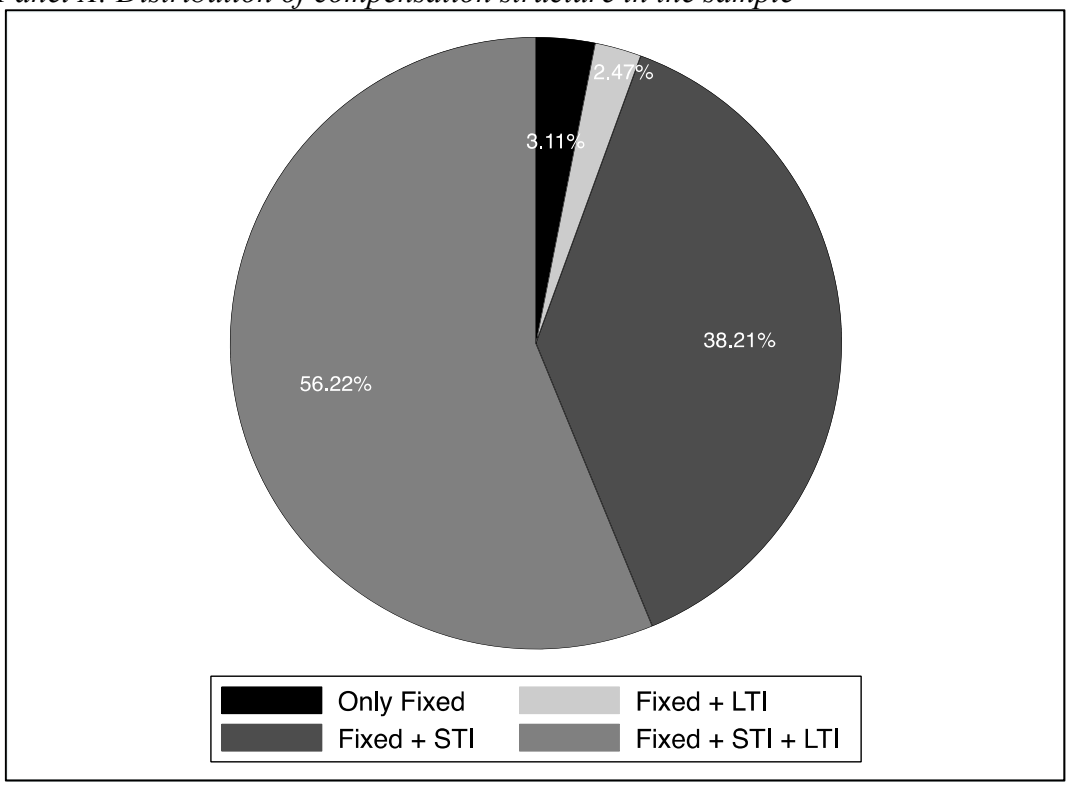
ASX Annual report 2018, p. 44:

Non-financial objectives	**Enduring trust, integrity and resilience**	Increase employees focus on risk awareness, accountability and speaking up	Board approved risk strategy. Risk culture action plan developed and in progress. Company wide risk culture workshops completed
			Enterprise risk management, technology governance and market oversight improvement plans designed and in progress
		Begin a multi-year project to upgrade secondary data centre	New site and vendor selected. Detailed transition plan developed
		No significant regulatory breaches (legal, compliance, finance, tax, operations)	No significant regulatory breaches
		Continue to align with Australian CCP risk regulations	95% of Financial Stability Standard assessment met target rating. 5% of assessment has plans in place to meet target
		All systems meet availability targets	Average system uptime for our critical systems over the past 12 months was 99.99%
	Providing innovative solutions and technology for our customers	Refresh BBSW benchmark methodology	New methodology successfully delivered
		Decision on using DLT for CHESS replacement Day 1 requirements and DLT implementation plan proposed	Completed. Consultation paper released outlining Day 1 scope and implementation plan
		ASX Net core infrastructure replaced and RBA and Austraclear clients migrated	Upgrade and migration commenced
		Articulate comprehensive digital and data centric strategy	Digital strategy and roadmap approved, execution underway
		Build new data and analytic products	Delivered new products including non-display, adviser and broker service provider products and completion of implementation of ASX24 trader terminals
		All employees to put forward two efficiency ideas	Completed. Many have been implemented delivering efficiencies internally and to our customers

FIGURES

Figure 1: Compensation structures

Panel A: Distribution of compensation structure in the sample



Panel B: Compensation structures over time

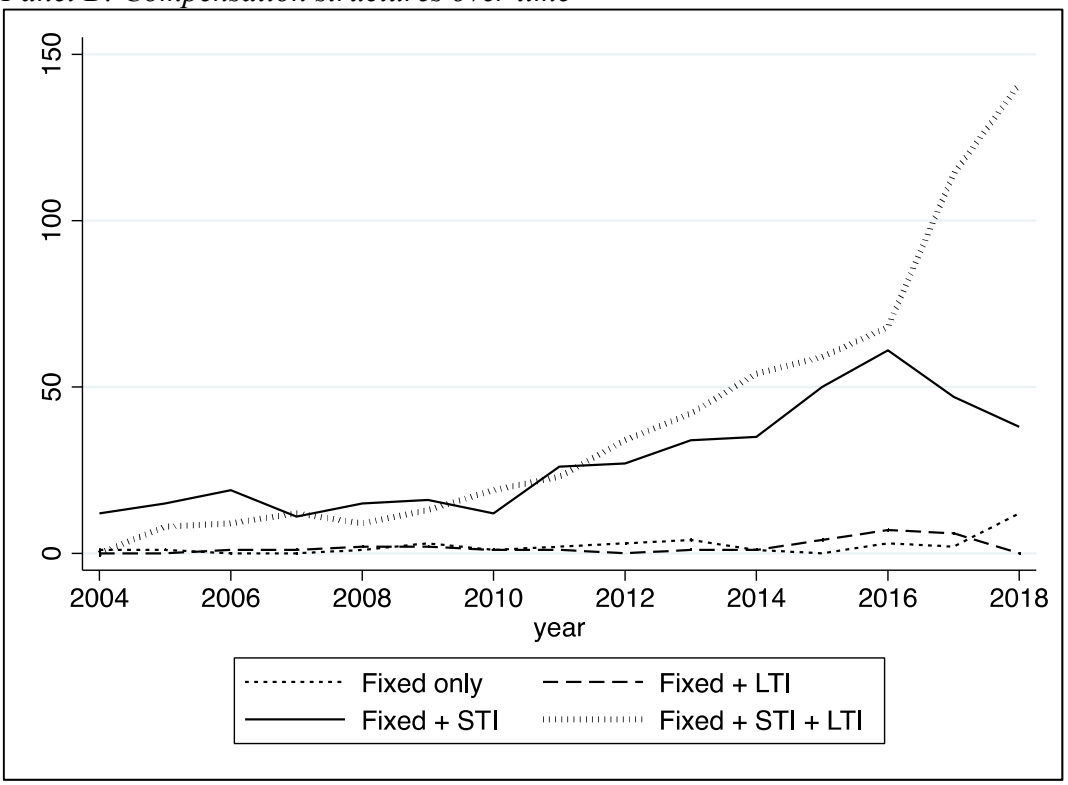


Figure 2: Compensation structure across industries

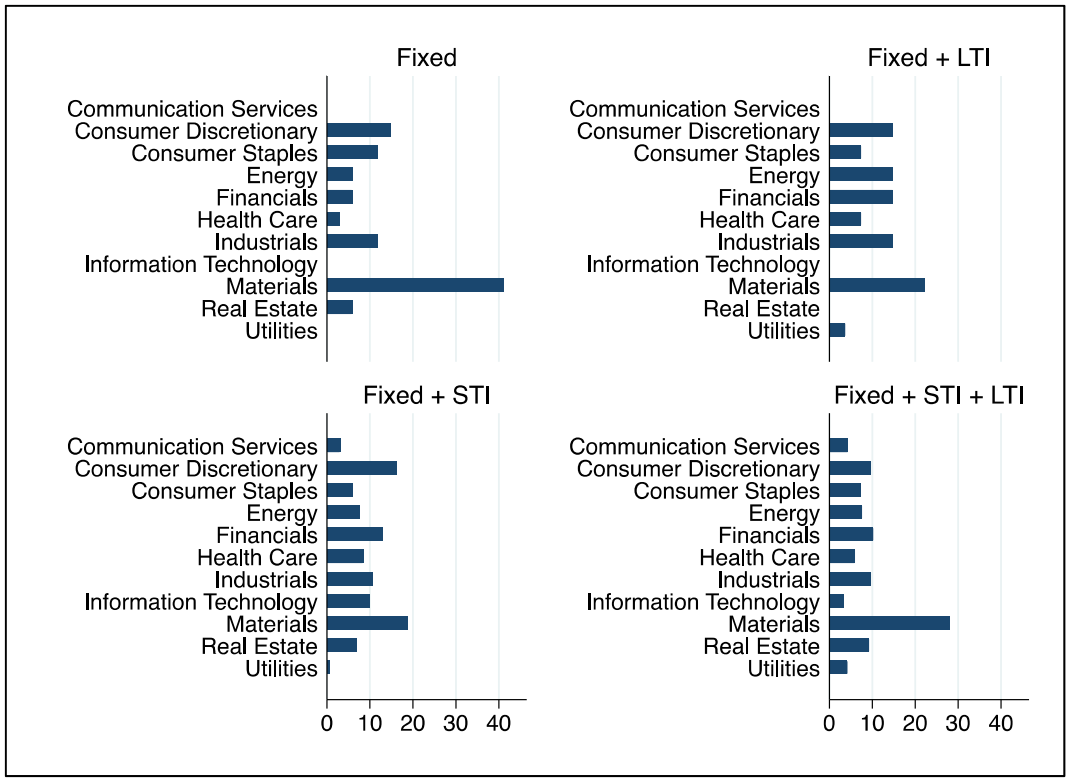
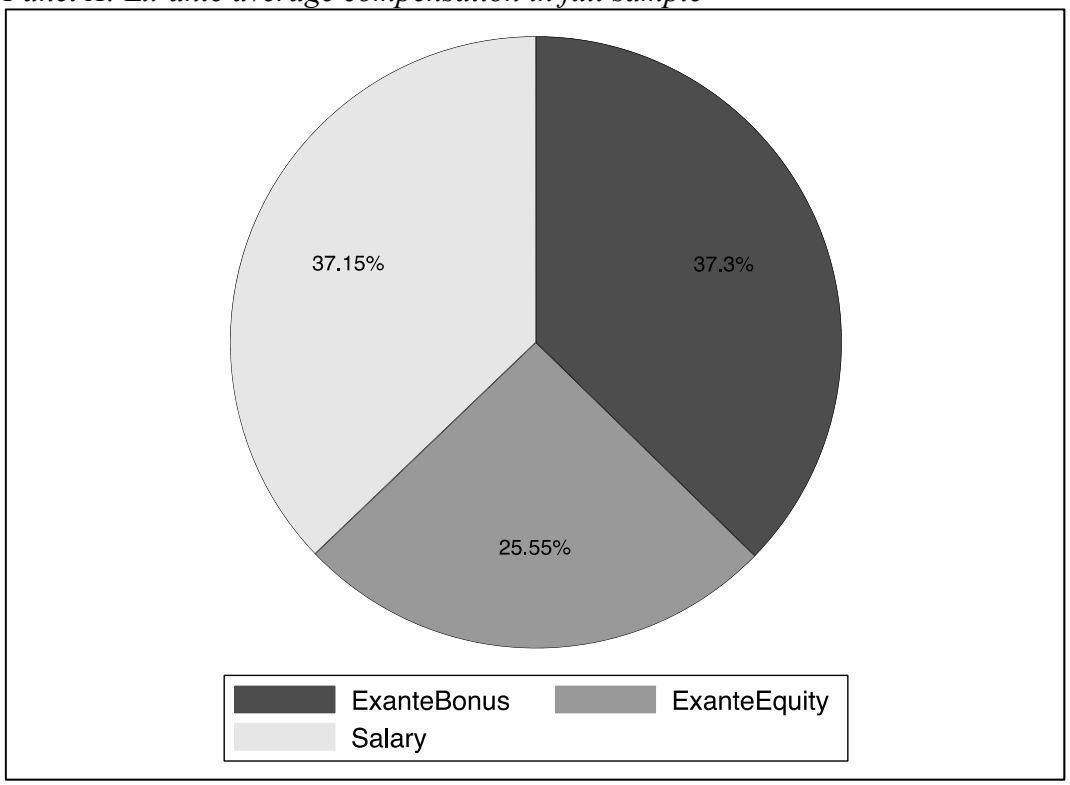


Figure 3: Ex-ante average compensation structure

Panel A: Ex-ante average compensation in full sample



Panel B: Ex-ante average compensation in sample of firms that have a fixed salary as well as both a bonus and equity component

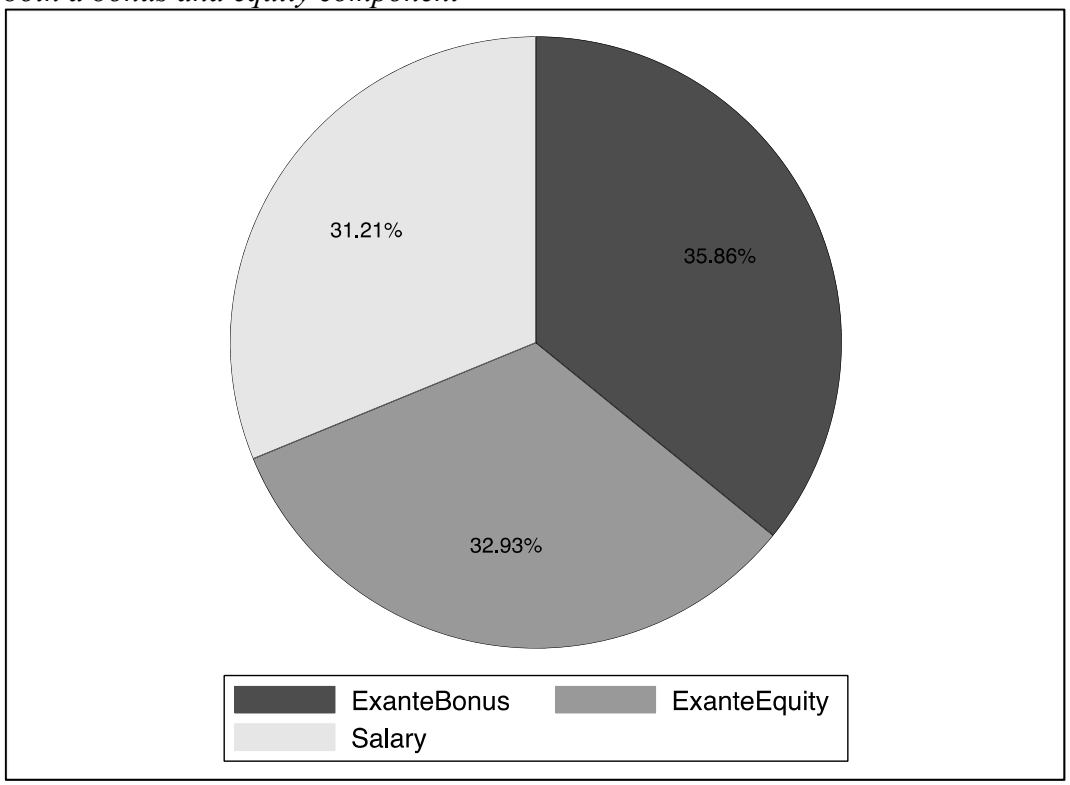
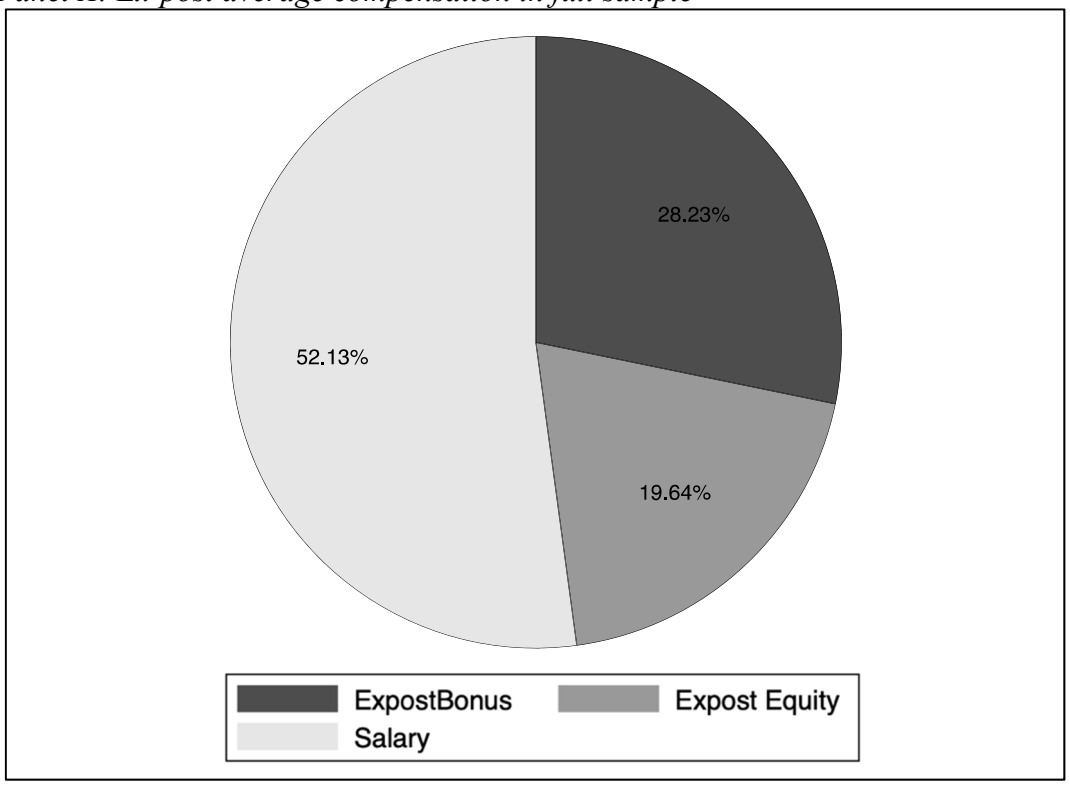


Figure 4: Ex-post average compensation structure

Panel A: Ex-post average compensation in full sample



Panel A: Ex-post average compensation in sample of firms that have a fixed salary as well as both a bonus and equity component

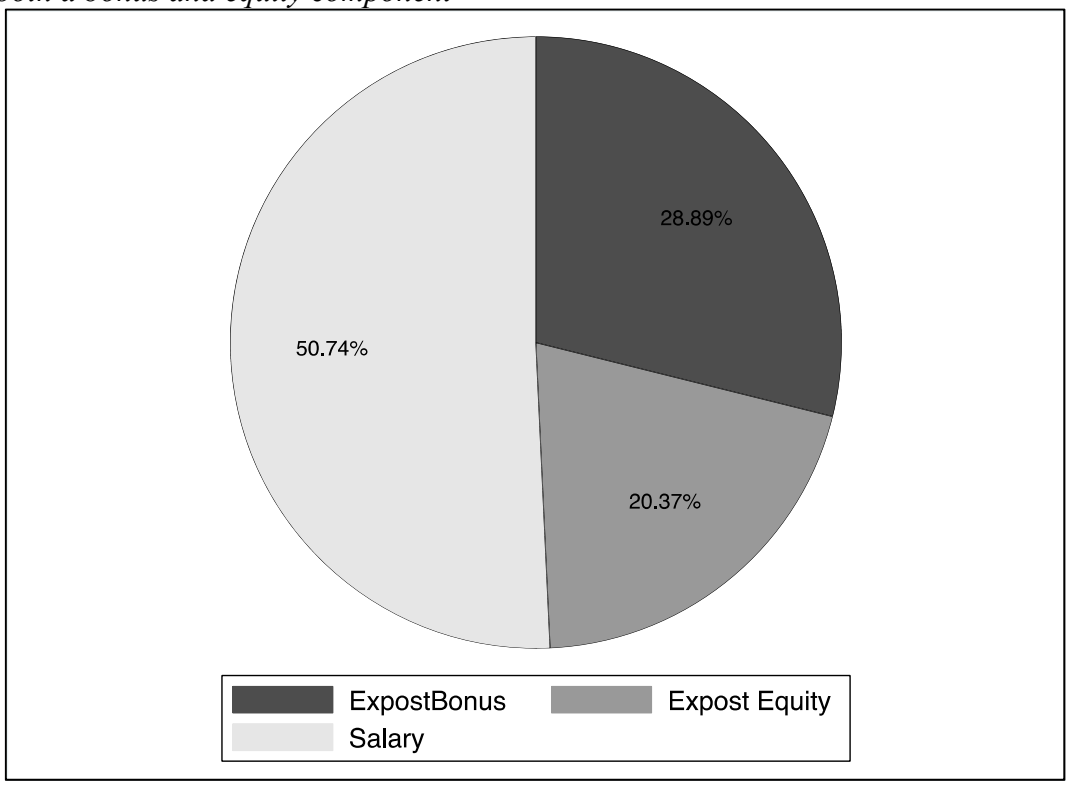


Figure 5: Financial performance target – frequency of use in isolation and in combination.

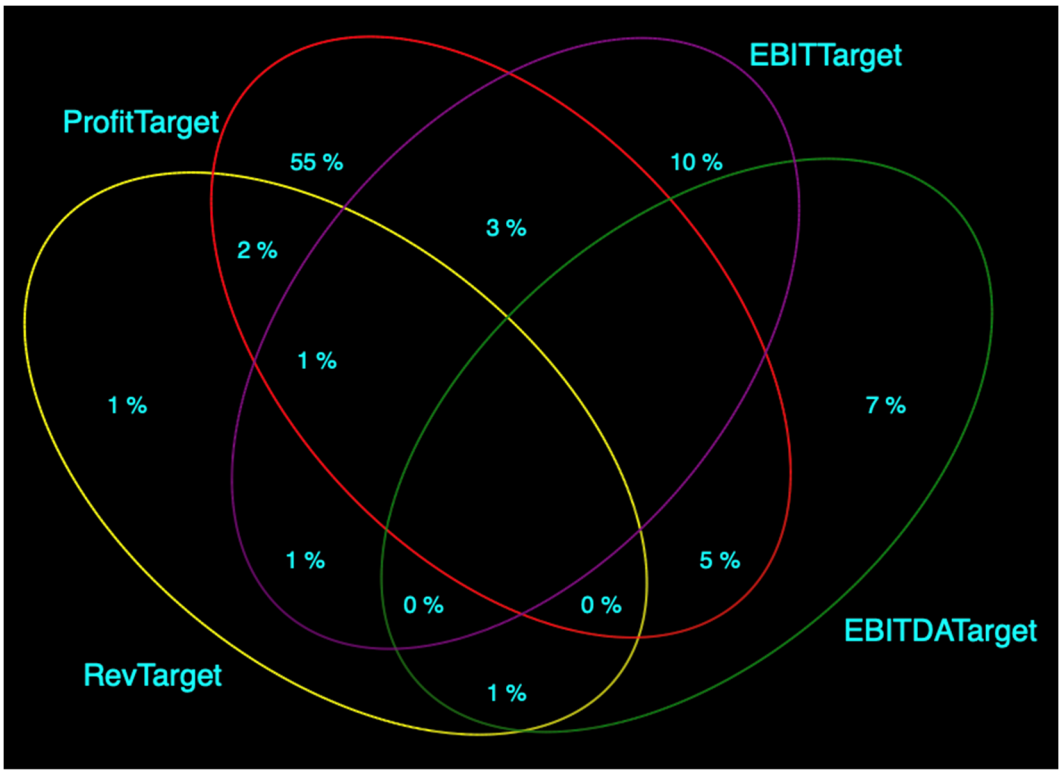
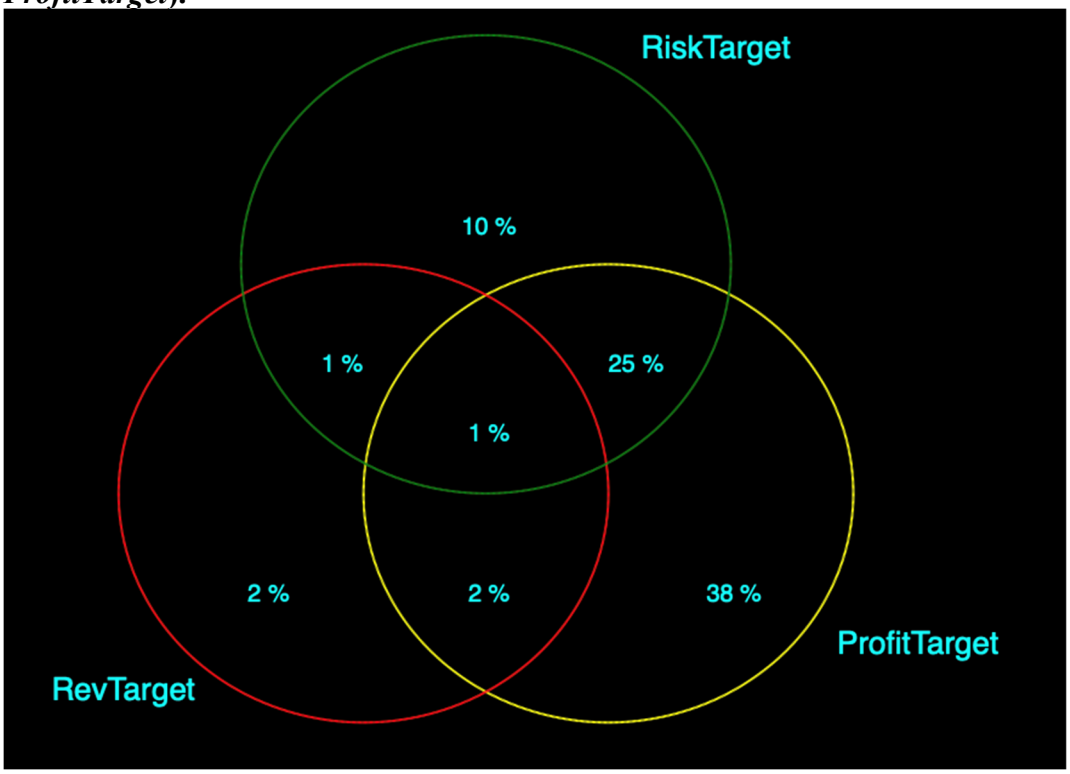


Figure 6: Non-financial performance targets – frequency of use and in combination with the least and most restrictive financial performance targets (*RevTarget* and *ProfitTarget*).



Additional table 1: Poisson regression model

Variables	(1)	(2)	(3)	(4)	(5)	(7)
			Patent(t+1)			
Total Compensation	0.086***					
	(6.167)					
%Incentive Compensation		1.710***				
		(4.204)				
%Bonus			1.327***			
			(3.825)			
%Bonus_NonFin				1.082		
				(0.860)		
RiskTarget					0.237	0.258
					(1.293)	(1.508)
No_RiskTarget					0.488	0.121
					(1.047)	(0.272)
%Bonus_Fin				1.766*		
				(1.819)		
CostShield					0.179***	
					(5.064)	
More CostShield						0.474***
						(3.534)
Less CostShield						-0.569**
						(-2.363)
%LTI			2.069***			
			(4.146)			
%LTI_Fin				0.392	-0.163	
				(0.237)	(-0.123)	
LTI More CostShield						-0.217
						(-1.313)
LTI Less CostShield						-13.361***
						(-16.386)
%LTI_Market				2.776**	1.555**	

				(2.438)	(1.998)	
LTI_Market						0.122
						(0.355)
LTI_TSR						0.256*
						(1.705)
LTI_ATSR				0.191		
				(0.670)		
%LTI_nonFin					-0.562	
					(-0.667)	
LTI_nonFin_Risk						0.604*
						(1.798)
LTI_nonFin_other						-0.294
						(-0.955)
Return	-0.028	-0.037	-0.038	0.024	-0.000	-0.047
	(-0.542)	(-0.519)	(-0.530)	(0.164)	(-0.001)	(-0.338)
Size	0.243***	0.186***	0.195***	0.263***	0.338***	0.277***
	(9.005)	(4.519)	(4.931)	(3.100)	(4.219)	(4.427)
CAPEX	2.725**	4.849***	4.908***	5.433***	6.047***	6.906***
	(2.045)	(4.300)	(4.305)	(3.121)	(3.355)	(2.965)
Analyst following	0.014***	0.015**	0.012**	0.020*	0.013	0.018
	(2.985)	(2.575)	(2.023)	(1.717)	(0.976)	(1.324)
Industry patent intensity	0.001***	0.001***	0.001***	0.002***	0.002***	0.002***
	(3.754)	(3.161)	(3.063)	(7.497)	(5.144)	(6.060)
Tenure	0.025*	0.035***	0.034***	0.035**	0.035**	0.058***
	(1.877)	(2.788)	(2.752)	(2.364)	(2.172)	(3.080)
%CEO Shares	-1.433**	-2.218**	-1.850*	0.894	1.066	0.440
	(-2.016)	(-1.967)	(-1.806)	(0.525)	(0.774)	(0.357)
Growth	-0.470*	-0.714***	-0.745***	-0.460	-0.640*	-0.321
	(-1.699)	(-3.324)	(-3.440)	(-1.028)	(-1.660)	(-0.753)
Mature	-0.488**	-0.695***	-0.713***	-0.565	-0.767**	-0.474
	(-1.961)	(-2.958)	(-3.054)	(-1.485)	(-2.559)	(-1.234)
Shake-out	-0.166	-0.301	-0.326	0.029	-0.203	0.036
	(-0.504)	(-1.123)	(-1.197)	(0.071)	(-0.658)	(0.101)
Decline	0.269	0.450***	0.386**	-0.732	-1.077	-0.371
	(1.591)	(3.121)	(2.461)	(-0.734)	(-1.085)	(-0.502)

Constant	-24.597*** (-17.564)	-22.457*** (-15.213)	-22.439*** (-15.312)	-8.278*** (-3.292)	-9.338*** (-4.017)	-8.151*** (-4.171)
Observations	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*	*1,318*
Year controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Additional table 2: Deferral scaled by total compensation (*ex ante*)

	(1)	(2)	(3)
Variables	*Patent t+1*	*Patent t+2*	*Patent t+3*
%Deferred_Total	-0.986***	-0.925***	-0.914***
	(-3.736)	(-3.557)	(-3.525)
Return	0.053	-0.005	0.023
	(1.113)	(-0.112)	(0.611)
Size	0.023	0.012	0.024
	(1.046)	(0.764)	(1.148)
CAPEX	1.152***	0.989***	1.054***
	(3.483)	(5.743)	(3.244)
Analyst following	-0.003	-0.003	-0.003
	(-0.668)	(-0.787)	(-0.585)
Industry patent intensity	0.001***	0.001***	0.000***
	(4.111)	(4.894)	(2.695)
Compensation	0.194***	0.235***	0.192***
	(4.650)	(7.526)	(4.668)
Tenure	0.004	0.004	-0.002
	(0.766)	(0.954)	(-0.388)
%LTI	-0.012	-0.036	-0.032
	(-0.282)	(-0.677)	(-0.747)
Growth	-0.030	-0.048	-0.045
	(-0.294)	(-0.952)	(-0.453)
Mature	-0.031	-0.059	-0.062
	(-0.313)	(-0.832)	(-0.643)
Shake-out	0.108	0.066	0.082
	(0.929)	(0.937)	(0.722)
Decline	0.064	0.038	-0.084
	(0.386)	(0.271)	(-0.506)
Constant	-3.146***	-3.624***	-3.263***
	(-5.834)	(-7.156)	(-6.148)
Year Controls	*Yes*	*Yes*	*Yes*
Industry Controls	*Yes*	*Yes*	*Yes*
Adj. R-squared	*0.308*	*0.313*	*0.268*